New York Railroad Club.

DISCUSSION

UPON

TECHNICAL SUBJECTS.

Meeting of November 21, 1895.

Published by the Club.
JOHN A. HILL, SECRETARY, 256 BROADWAY,
NEW YORK.

1895.

New York Railroad Club.

OFFICERS FOR 1895-6.

President,

GEORGE W. WEST,

Superintendent of Motive Power, New York, Ontario & Western Railway

First Vice-President,

A. E. MITCHELL,

Superintendent of Motive Power, N. Y., Lake Erie & Western Ry.

Second Vice-President,

H. H. VREELAND,

Master Mechanic, Delaware, Lackawanna & Western Railway.

Third Vice-President,

C. M. MENDENHALL,

President Metropolitan Railway Company.

Secretary,

JOHN A. HILL,

Editor Locomotive Engineering.

Treasurer,

C. A. SMITH,

Master Car Builder, Union Tank Line.

Executive Committee,

W. C. ENNIS,

Master Mechanic, New York, Susquehanna & Western.

W. W. SNOW,

President Ramapo Iron Wor s.

W. G. WATTSON,

Superintendent West Shore Railroad.

Finance Committee,

F. M. PATRICK,

H. W. Johns Manfg. Co.

R. M. DIXON,

Engineer, Safety Car Heating & Lighting Co.

D. M. BRADY,

Brady Metal Company.

PROCEEDINGS

OF THE

New York Railroad Club.

Meeting held at the Rooms of the American Society of Mechanical Engineers, 12 West Thirty-first Street, New York, on Thursday Evening, November 21, 1895.

President West called the meeting to order at 8:15 P.M.

By direction of the President the Secretary read Section 3 of Article 8 of the Constitution relative to the election of officers.

On motion the calling of the roll was dispensed with.

The Secretary read the Minutes of the meeting of October 17th, which were approved.

Secretary Hill—Our committee to the meeting at Pittsburgh of the Master Car Builders and representative members of different clubs, should report this evening. Mr. Mendenhall is chairman.

Mr. Mendenhall—I will say that there was rather a full meeting in Pittsburgh on the 14th inst. The Rules of Interchange were gone over very thoroughly and revised on the lines of the rules proposed by the Southern and Southwestern Railroad Club last year or the early part of this year, and, after a day of hard work, the compiling of the revision was left in the hands of a committee of three, composed of Mr. Bronner, Mr. Waitt and Mr. Nelson; we are to arrange the rules, have the arrangement printed and furnish each committee with a number of copies to be presented

to their several Railroad Clubs, and these to be discussed at the January meeting, the understanding being that the chairman of the Pittsburgh meeting would communicate with the Presidents of the several clubs and ask them to set aside the January meeting to discuss this rearrangement of the rules. Then the plan is for the General Committee to meet again, after the publication of the proceedings of the Railroad Clubs of January, and prepare their final report to submit to the Arbitration Committee as soon as they can.

The President—I have a letter from Jno. S. Lentz, Chairman of the Pittsburgh meeting, which reads as follows:

President, New York Railroad Club :

Dear Sir—At a meeting of the representatives of the several railway clubs, and of the private line companies, held at Pittsburgh on the 14th inst., for the revision of the Rules of Interchange, I was instructed to request the presidents of the several clubs to make the Rules of Interchange a subject for discussion at the January meeting of the Clubs.

The Rules as agreed upon by the Joint Committee will be printed and submitted to the Clubs at the January meeting, by the chairman of the committee appointed by each Club.

The joint Committee instructed me further to request that you make a special effort to have the proceedings of the January meeting printed as early as possible, so that the committee may have the benefit of the discussions in time for their final meeting to be held at Cleveland on February 26th, 1896.

Yours truly,
JOHN S. LENTZ, *Chairman.*

Mr. Mitchell—I notice that the Chairman of that Committee states that the copies will be presented at that meeting. I think it would be better if the copies were mailed to each member of the Club previous to the meeting. I would move, therefore, that the Chairman of this Committee be instructed to send sufficient copies to the secretary of each Railroad Club at least one week previous to the meeting.

The motion was carried.

Several candidates declined to run for offices, and a letter to

the same effect was read from a member of the Executive Committee, who was also a candidate, but no action could be or was taken in the matter.

The Secretary read his Annual Report, which was as follows:

New York, November 21st, 1895.

To the Officers and Members of the
New York Railroad Club :

Your Secretary would respectfully submit the following report:

During the year just passed we have increased our membership from 434 to 525—a gain of 91.

Your Secretary has received from the sale of reports during the year	$273 00
For advertising	1,261 30
For dues	900 00
Making the total receipts	$2,434 30
There is still due from advertising	$840 50
And for dues	182 00
A total of	$1,022 50

Considerable of this money has been paid since the books were closed.

The report of the Treasurer shows our total expenses for the year and our cash balance.

The affairs of the Club are certainly in a flourishing condition financially, as well as in the accession of new members and the interest taken in discussion.

Respectfully submitted,

JOHN A. HILL, *Secretary.*

The Report of the finding of the Finance Committee on the books of the Secretary was then read, as follows:

New York, November 21st, 1895.

To the New York Railroad Club :

I have to report that I have carefully examined the books and mailing lists of Mr. Jno. A. Hill, Secretary of the Club, and find

them correct, except that he has twice charged himself with six dollars ($6), received for dues, which error has been corrected.

The amounts due the Club are:

For unpaid dues, 91 members	$182 00
For advertisements................................	840 50
	$1,022 50
All bills presented have been paid except for error mentioned..	$6 00
For salary of Secretary............................	600 00
	$606 00

Respectfully submitted,

FRED. M. PATRICK,

Chairman Finance Committee.

On motion the Reports were ordered received and placed on file.

The Secretary then read the Report of the Treasurer for the fiscal year, as follows:

To the Officers and Members of the New York Railroad Club :

Your Treasurer would report for the fiscal year ending November 21, 1895:

Nov. 16, 1894. Cash on hand in Mechanics' National Bank..	$1,116 69
Received from St. Nicholas Bank in full for all claims..	360 54
Received from Secretary	2,434 30
	$3,911 53
Expenses as per vouchers enclosed..................	2,648 01
Balance on hand November 21, 1895...........	$1,263 52

All bills audited are paid.

Yours truly,

C. A. SMITH,

Treasurer.

The finding of the Finance Committee on this report was as follows :

NEW YORK, November 21, 1895.

To the New York Railroad Club :

I beg leave to report that I have carefully examined the books

and vouchers of our Treasurer, Mr. C. A. Smith, and find them absolutely correct.

His receipts have been :

Balance from previous year..........	$1,116 69	
From Mr. J. A. Hill, Secretary, for dues ...	900 00	
From Mr. J. A. Hill, Secretary, for advertisements..............................	1,261 30	
From Mr. J. A. Hill, Secretary, for extra reports..................................	273 00	
Remainder of deposit, St. Nicholas Bank...	360 54	
		$3,911 53

And he has paid on vouchers :

For printing, mailing and stationery........	$1,505 51	
Rent....................................	235 00	
Stenographer and Treasurer's Clerk........	168 00	
Entertainments, seven meetings...........	440 00	
Entertainments, smoker...................	299 50	
		$2,648 01
Balance in Mechanics' National Bank..........		$1,263 52

Respectfully submitted,

FRED. M. PATRICK,

Chairman Finance Committee.

These reports were, on motion, ordered received and placed on file.

Mr. Ecclesine—I suppose I will make myself unpopular, but I would like to say that there is an expenditure of money going on in the Club that I think is uncalled for. I think it is not necessary to have a lunch or a banquet, or refreshments, at every meeting of the Club. I do not want to limit the Executive Committee at all in their expenditures. It would not become me to do so, because I have several times asked for appropriations by this Club for social purposes. But I do not think it is a proper expenditure of money to have a supper at every meeting of the Club. We might have three or four every year—one at the Annual Meeting, one at a social meeting of the Club, if it chooses to have one, and one at the close. But I think to have a supper every time that the Club meets is not a part of the spirit that the Club was organized for.

The President—If there is nothing further to offer under this head, we will pass to the next order of business—Discussion upon Technical Subjects. The Secretary will announce the subjects.

Mr. Mitchell—As we all have our ballots in our hands, I move that the election of officers take place before the discussion of the topic of the evening.

Mr. Parke—I move as an amendment that we take a recess of ten minutes to cast our ballots.

Mr. Mitchell accepted the amendment and the motion was carried.

A recess of ten minutes was then taken, and the ballots deposited with the tellers.

The President—The topic for discussion is as follows : " Is it good policy for a railroad to manufacture, to any considerable extent, in its own shops, articles for repairs to either cars or locomotives that can be purchased in the open market." I have asked Mr. Mitchell if he will kindly open the discussion.

Mr. Mitchell—The railroads of this country were originally built for the purpose of conveying freight and passengers between towns or cities. They were built for that special object, and when they were incorporated the idea was simply to act in that capacity. Gradually, however, large railroads have introduced the system of manufacturing all supplies that they find necessary to use, outside of plate steel and such heavy work that they could not afford to manufacture. You will find that to be notably the case on Canadian railroads and English railroads. But in this country the roads, as a rule, only manufacture what in their judgment they can manufacture cheaper than they can buy. Yet in estimating what would be cheaper than they can buy they often neglect the fact that they do not charge into the cost of articles the freight on the crude material, the use of cars in transporting that material, which could be used otherwise in earning money for the company. Neither do they charge in, as a rule, any portion of the general office expenses or the interest on the money invested in the plant, or wear and tear of machinery. They generally consider that that has got to go on anyhow, and it is chargeable to the repairs of locomotives or cars. In my own judgment it is not good policy for a railroad company to manufacture what they

could purchase outside; because, in doing that, the labor that is engaged for that purpose must be taken off from the general work of repairs of locomotives and cars, which is necessary for the successful operation of the road, and if goods are manufactured in the shops it is necessary to keep a larger number of mechanics, which in dull seasons is a burden to the company. They must necessarily be discharged, or the entire force placed on short hours. I think it is a fact that railroad companies are looking into this more than ever, by the large orders which have been placed lately, for Fox trucks, for instance. We all know that the diamond truck costs a great deal of money to maintain, and we are very anxious to throw that labor out of our shops. To do that we have been buying a truck manufactured outside entirely. We can say the same of a great many things. Take, for instance, frames on locomotives—where we build a locomotive, perhaps, for renewal of an old one, we are gradually getting to buy our frames outside, because manufacturers can forge, plane and slot a frame ready for drilling cheaper than railroad companies can, if every thing is considered. Railroad companies, however, must manufacture certain things as a matter of economy, for instance, bolts. We have a large number of rods and old bolts of long length which are broken in service. Instead of scrapping that iron it is economy for the company to work it over for bolts of shorter length. We must repair certain things. We must manufacture our lumber, for instance, to put in cars for repairs. But, as a rule, railroad companies, if they can purchase their cars outside, prefer to purchase them because they get quicker delivery, and the shops can be utilized for the purpose intended, that is, repairs.

Mr. Wattson—May I inquire about some of the smaller items—for instance, brasses? Would you buy them or manufacture them?

Mr. Mitchell—I would say, in answer to Mr. Wattson, that so far as the Erie Railroad is concerned, five years ago we shut up our foundries, preferring to buy our cast iron outside. The question was considered of hauling our iron ore, hauling our pig iron and fuel to the shops and distributing the castings. Taking everything into consideration, we found that we could buy our castings

as cheap outside as we could manufacture them. Our brasses we buy entirely outside. In fact, we have not made a journal brass for a long time. We even buy our tinware outside. We think it is cheaper to let the manufacturers make the tinware to our standards than to make it ourselves.

Mr. Higgins—I would say that when I commenced railroading the company I was with then thought it was the right thing to manufacture everything they could, and buy nothing unless they had to. I started in with the Erie road—the road that Mr. Mitchell is now with—and that road has certainly now gone to the other end of the string. I quite agree with what Mr. Mitchell has said, though, that railroads should stick to their legitimate business, of transporting passengers and freight. There is one thing that I believe should govern this matter, no matter what we may think about it, and that is this fact: the capacity of the shops has not increased in the last ten years at all in proportion to the increase in the business and the increase in the equipments. The cars and engines are more in number, and are wearing out faster, and we have reached that point where it is impossible for the railroad shops on many roads to turn out or to manufacture material soon enough and in sufficient quantity to meet the demand. The road I am with now is manufacturing to the extent which they think is profitable, but even with that limitation they find it necessary frequently to go outside and buy parts that we have been in the habit of making, simply because we have not the capacity to turn out the work when it is wanted, and I believe that that fact is going to force the railroad companies out of the manufacturing business.

The President—I know it has been the experience of the Ontario & Western that we can buy the manufactured article in a great many instances cheaper than we formerly bought the raw material. Our business increased on the O. & W. almost double between the years 1889 and 1891, and we proved in those two years that in the item of brasses alone we could buy the manufactured article for a less total amount than we had formerly paid for the raw material. We not only purchase our brasses, but we purchase our iron castings, bolts, nuts and forgings. Referring to the matter of bolts, we utilize the old bolts, but always in shorter lengths. If we have a 16-in. bolt that is broken off at the end of

the thread, we would not scrap that bolt; we would make a 14-in. bolt of it. We very seldom order the shorter lengths of bolts. We have enough of the old bolts to make the shorter lengths, but all the purchases are of the longer lengths. We have recently gone into the purchase of arch bars and brake levers. Any standard material, we find, we can buy in the open market as cheaply as we can, in a great many instances, get the raw material.

Mr. Mitchell—The General Storekeeper of the Lehigh Valley is here, and he can probably give us some information.

The President—Mr. Coleman, we would be very glad to hear from you.

Mr. Coleman—Mr. President, this is a subject in which I am very much interested, and it is one to which we have, in the last few years, been giving considerable attention. A general answer to the question would be, so far as our experience has gone, that it would be decidedly profitable for a railroad to buy its material outside. However, when you come to analyze the special items, that has to be modified to meet the conditions. In the matter of bolts, I have found that it pays us to purchase our smaller bolts. By that I mean bolts up to ½ in. by 3 in. in length, but that it pays us to continue manufacturing larger sizes of bolts, for the reason that we are able to make about 45 per cent. of our car bolts out of old bolts and rods which are too badly bent to warrant straightening for the purpose for which they were originally used. It may be of interest for you to know that it is now costing us about fifteen hundredths of a cent per pound to handle our scrap rods and scrap bolts. By that I mean that the cost of handling from the car, when the car reaches the scrap platform, to the time in which it is returned to the shops, so that our average cost for all the bolts required for our freight equipment is far below what we could purchase bolts for outside. It would be cheaper for us to buy the new bolts if we did not have the scrap, but it is necessary for us to make the new bolts in order to handle the scrap economically. In the matter of castings we have found that it is economical to purchase our brass castings, our bearings, and our engine castings, outside. We have not found it economical to purchase our gray iron castings. We are now making gray iron castings cheaper than we have been able to get a proposition from

any outside concern for making them. With a number of the minor items, such, for instance, as handles for lubricators, items of that character, set screws, and a number of those small items which are made specialties of by manufacturers, we find that we can purchase them from 10 to 40 per cent. cheaper than we have ever been able to manufacture them. That is largely due to the fact that manufacturers make large quantities of certain sizes of bolts, certain sizes of set screws, certain sizes of handles, whereas a railroad company makes a few of each kind, and therefore makes it necessary to change the machines. In the matter of tapping nuts, we found that to be the case in particular, that the cost of changing the taps would naturally run the cost up so that we could not compete with the manufacturer in that, and we therefore buy all our nuts tapped, and that holds good in almost everything that is a specialty. So that the question narrows itself down to the particular conditions that exist at a certain shop. In the majority of cases I think undoubtedly the railroad company saves money by purchasing the articles required for its equipment.

Mr. Ennis—Mr. Chairman, my experience is about what you stated and what Mr. Mitchell stated. I think decidedly we can, to a great extent, buy articles manufactured by outside parties cheaper than we can make them. In the matter of brasses I am satisfied of it; also of forgings.

Mr. Cronise—I do not know whether it is quite in order for a supply man to take up this part of the discussion; but as an ex-railroad man I might possibly be allowed to speak on both sides of the question. To begin with, this is an age of specialties and specialists. The railroads themselves are manufacturers to a larger extent than any other special industry in the world. They are manufacturers of transportation, and on general principles their time and all their facilities should be taken up with the manufacture of the best class of transportation, freight and passenger that they can furnish. A manufacturer who starts to manufacture a special article, equips his plant to turn out that article in the best possible manner and at the least possible cost,so that a railroad company, devoting itself to the subject of transportation, should on the general principle confine itself to the manufacture of transportation, because they are not as well fitted to manufac-

ture specialties or other articles in connection with the equipment of their lines as other large manufacturers who have constructed plants especially for the purpose of manufacturing those articles. Now we all know that many years ago a large part of the railways started to manufacture to a very large extent; take the Baltimore & Ohio Railroad, for instance. In early times they started to manufacture their rails at Cumberland. That mill is now being run by the Cambria Iron Company; so that, with a few exceptions, it can safely be said that there are few articles that can be manufactured by a railway company, unless their requirements are so very large that they have special plants equipped with special tools and operated by a special class of workmen constantly busy.

So far as working up scrap, for bolts and things of that sort, of course a railroad company is in a position to turn out that kind of work profitably, and keep a class of men and boys working up their bolts and working over other parts of their scrap pile to a considerable advantage, and in slack times turn them over on other kinds of work. Sufficient attention undoubtedly is not paid by railroad companies to working over the scrap piles. If they did pay more attention to that and less attention to turning out special classes of work relating to cars and locomotives, there would be probably a good many roads able to turn deficits into profits. So I am of the opinion that on general principles a railway company, up to a certain point, should confine itself to the maufacture of transportation, within certain limits, of the best possible character, leaving the manufacture of special articles to manufacturers who have made a specialty of that sort of thing, and can, as a general rule, give a better grade of goods at a lower price.

Mr. Vreeland—It seems to me that this question should go back and inquire into what caused the railroads to first go into manufacturing. I have recently, in preparing an article on the street railways of America, had occasion to ask for data all over the United States with reference to the electric railroads, and while asking for the data necessary for this article, I asked all the lines embraced in the operations of our syndicate, as well as the larger electric lines of the country, the question, "What they manufacture and what it costs them to manufacture; and if the manufacture of

those various articles had been discontinued, and the cause for the discontinuance." Every answer in every case was—to force down prices. One of the large Eastern systems, which was the first in the electric field, wrote quite an article in reply to my question, and said that in starting out to equip a large system, all of the manufacturers that were turning out the necessary equipments were crowded with work turning out the complete articles, and that no attention was given to the working parts of them, and where they went to them for prices on the working parts, the prices were very high. This company expended $600,000 in equipping a foundry, a general plant, for the manufacture of the various wearing parts of motors, trolley wheels, gearing and things of that class. They have since discontinued, and charged the plant off to profit and loss—such portions of it as they could not dispose of. They claim that they are some hundreds of thousands of dollars *in* by the operation. For instance, one thing that I recall, was on the trolley wheel, which wears out very fast. Five years ago trolley wheels were quoted to them at $3.50. They turned it out for 75 cents, and forced the manufacturers down to 65. It was not a question with the manufacturers at that time as to what the thing was worth, but what they could get for it. For instance, the motor equipment of a car cost $2,500 about four years ago. I placed an order the other day for the same thing for $675. That is brought about by competition, of course, but when you come to special parts, those things have become specialties in the last few years, and to-day in the operations of our syndicate over the country, there is not a single maintenance part of equipments manufactured by us. The question has been up and has been considered very thoroughly, and with the many miles we have in operation and the large amount of equipment, it is considered by the companies that those engaged in the manufacture of the specialties of the trade can manufacture them much cheaper than the various companies can. The only instance in the country I struck where they are continuing largely in manufacturing is in the extreme West, and there they claim that the manufactories, being in the eastern part of the country, it was next to impossible to get quickly what they wanted, and they went ahead and manufactured. Now it is a question in my mind if the steam railroads did

not go into manufacturing for just exactly the same purpose. There were not many locomotive manufacturers and car builders when they started out. The roads grew very rapidly in mileage and equipment, and the various companies were led into this manufacturing by necessity, and it is only of late years that they have given consideration to the question as to whether it was cheaper to buy in the open market than to manufacture. I say, so far as our experience is concerned with the street railways, we do not manufacture anything at all. Of course, it is rather presumptuous for a street railroad man to say anything on this matter, but I was only leading up to what the causes were, to show what possibly might have started manufacturing on railroads. (Applause.)

The President—The experience of the street railroads is very profitable to us, and I believe that their experience in this respect has been what was formerly the experience of the steam railroads.

Mr. Parke—I have been much interested in what Mr. Vreeland has said as to the probable causes of the railroads manufacturing for their own use. It seems to me that there is a pretty evident reason for the railroads beginning that course.

It is not a great many years since that a carpenter, in order to get a good job, had to be what is called an "all around carpenter." He had to be able to do anything that was given to him to do. It was likewise necessary for a machinist to be able to turn his hand to anything that he was called upon to do. I dare say that if either a carpenter or machinist went to any shop foreman or master mechanic or car builder to-day and applied for work, and was asked what he could do, and he said, "anything," I do not believe he would get a job. In a machinist you want a bench hand or a lathe hand, or a man who has been specially drilled in some particular kind of work. In early days, if you wanted certain articles manufactured, you went to a machine shop where they had their own foundry, and their own brass foundry, and they manufactured your article; it might be a fine tooth comb or it might be a steam engine. Whatever you wanted they would manufacture for you. There was no earthly reason why the railroad shop was not just as good a place to do that in as any other shop which had corresponding facilities. However, with the growing demands for large quantities of special kinds of manufactured articles, it

became apparent long ago that it was absolutely essential to devote space and time and facilities for carrying on special kinds of work. The railroads have maintained pretty much the same character of general facilities that they have had in the past, widening them somewhat, that is, extended their general facilities, but not their special facilities, a great deal, whereas locomotive builders, car builders, manufacturers of all kinds of supplies, have been putting in special machinery and drilling men especially to do one kind of work year in and year out, and they can do work a great deal cheaper than could possibly be done in a general shop. As an illustration of this, we are furnishing a great many thousand sets of air brakes for cars every year. For those brakes all the triple valves that go out are required to be machined in a certain way, and three machines do the work upon all the triple valves in the United States. No triple valve would be well made and suitable for the best use unless it was put through that process, and if the railroads all manufactured their own triple valves, every railroad would have to have one of those machines. The railroads throughout the country are now quite vigorously entering into the equipment of their cars with couplers and air brakes in accordance with the requirements of the law. In going about among railroad officers I have frequently had an opportunity to see the estimates of car builders and superintendents of motive power of the cost of doing the work. I have been more especially interested in the estimated cost of applying the air brake to freight cars, and I have a pretty fair general idea of what that work costs, and what car builders think it is necessary to spend in order to do the work. I have been very much interested within a few days to learn that one of the car manufacturing concerns of the country has extended its facilities for making forgings considerably, with a view to furnishing to railroads the Master Car Builders' brake gear upon designs for their own special cars, in styles and proportions of levers that they require—jaws and fittings throughout—and they are offering to sell to the railroads the Master Car Builders' brake gear complete for a price that is about one-third of the lowest estimate that I have seen handed in by car builders to their superior officers. I do not believe there is a railroad in the country that can afford

to manufacture the Master Car Builders' brake gear to put on its own cars in view of such prices as these that I have seen. There are other car builders that may have this thing in mind, but I refer specifically to Jackson & Woodin. It seems to me that is a very good illustration of the advantage that comes from single manufacturers, that is, for manufacturers of a certain line of goods turning out large quantities over and above that which would be possible to reach in shops where mixed work is done, and the use of tools divided among different things, and the time of the men the same way.

Mr. Mitchell—I think that one good reason why railroad companies are giving up manufacturing articles is because the shops were equipped with tools years ago. Those tools are used to-day—some of them twenty-five years old. The tools are doing good work, to be sure, to-day, and are in a good state of preservation. But where a planer bed ran 10 feet or 20 feet a minute then, they run 50 and 60 feet a minute to-day. Old frame slotters would only slot one pair of frames, the Baldwin Locomotive Works have a slotter that will slot four pairs of frames. In a car shop a Daniels' Planer planed one side of a timber at 4 feet a minute, the modern planer will plane four sides 60 feet a minute. Those are the reasons we cannot compete with outside manufacturers. We cannot afford to put new tools in our shops. The old ones are good enough to repair the engines. We surely ought to keep up with the times and speed up our machines if possible, or sell them or exchange them for better; but we cannot afford to change the entire equipment of our shops every ten years to keep up with the times.

The President—I think that the price that some of the car manufacturing companies name on grab irons complete is one of the best illustrations on this subject that could be had. Many of them are offering the grab irons complete at about the prices that we have to pay for the iron.

Mr. Mitchell—On that line we had a very curious thing about grab irons in our shops. Some shops were making them for five cents apiece, and others for three-quarters of a cent apiece, that is, for labor. They have all got down now to less than a cent, I believe.

Mr. Wattson—Mr. President, I think it pays a railroad company to do a certain amount of manufacturing, not for the economy to be derived from the manufacturing in itself, but in the interests of the whole service. For instance, every railroad has a dull period, and I believe it is economy for a railroad company to maintain a permanent force in its shops of efficient, worthy men, and when it does, such men should have permanent employment throughout the year, and when the dull period in business comes, when the necessary repairs of cars and locomotives is curtailed, it would pay a railroad company to turn their attention to manufacturing in the way of rebuilding cars which have been destroyed, sufficiently to keep up its complete equipment list, and also in the rebuilding of locomotives. But further than this manufacturing will not pay. The reasons why it will not pay have been pretty clearly stated here to-night. It is simply a matter of competition, and I can illustrate this point by referring to a conversation I had with a gentleman a few nights ago. He told me he had been selling a certain railroad company paint for about 90 cents a gallon, but during the hard times he had cut the price down to 80 cents, and it was hitting him pretty hard. But he had been up to see the purchasing agent a few days before and found out that some other manufacturer had come in and offered just the same kind of paint for 60 cents a gallon, and this other man had the order. Now that is what competition does for the railroads. A railroad company, as a manufacturing company, has no competition, and therefore it has not the incentive to reduce the cost of doing its work to the same extent that one manufacturer is always trying to outdo the other, and further, a railroad company has not the choice of location for placing its plant where all the conditions of labor and raw material will combine to produce the cheapest article. The manufacturer has all these advantages at his disposal, and in this way he is able to down the railroad company every time when it comes to the matter of cost in producing an article.

Mr. Higgins—Mr. President, the remarks made by the last speaker in regard to the advisability of railroads going into the manufacturing business in dull times in order to keep a permanent force might be all right in theory, but I do not think it will work

out in practice; because, when dull times come, the men who are responsible for the financial condition of the road immediately commence to look around to see where they can reduce expenses. The first department usually to suffer is the shop. The shop is put on short time, and is, as a rule, only able to keep up the necessary repairs. The manufacturing of articles, if not economical at one time, it seems to me is hardly economical at another time, when the revenue is decreasing.

Mr. Wattson—Is not Mr. Higgins a little wrong in his basis? He says it is all right in theory, but it is no matter what the theory is if the principle is all right. I think it is the right principle that a railroad company should maintain a good and efficient working shop force as one of the most useful and important adjuncts of its service. If the management wants to go against good practice and curtail its expenses by knocking out these useful adjuncts of good men and efficient labor, why, I do not think the principle is at all altered.

Mr. Fowler—Is not this a matter largely of geography, quantity and the purchasing agent? As Mr. Parke says, if a railroad company consumes enough of any one article to keep machines busy at all times, certainly they ought to be able to manufacture as cheaply as an outside manufacturer. The purchasing agent element comes in in the case stated by Mr. Wattson about paint. In the matter of geography, possibly, a road may be so situated that it can manufacture its own supplies very much cheaper than it can buy them. There is one road in this country that is peculiarly situated in this respect; that is, the Grand Trunk of Canada. They manufacture nearly everything they use. They roll their own rails, manufacture their own wire nails, do their own nickel plating, gold plating and silver plating, and there is hardly a line of goods that is used on the road that they do not make themselves. They hammer out all of their own axles and work up their own scraps, and build a great many of their own machine tools, simply because there are very few manufacturers in Canada and the customs duty are very high, so that it is cheaper for them to carry on these manufactures than to buy them from outside manufacturers. As I say, all the wire nails used on the road are manufactured in the Grand Trunk shops in Montreal, and they

find that they can make them for just about the same price that the manufacturers can make them, and, working on that basis, they find that everything is cheaper for them to make than it would be to buy. There is one item which they have down to a very low point, and that is the silver plating and burnishing of headlights. That has been found to be very much cheaper in this country, and on one or two roads centering in New York, where they are doing their own silver plating and their own burnishing, they are getting very much better results than they can get from the manufacturer; not that the manufacturers cannot do just as good work, but they do not, owing to the influence of the purchasing agent in cutting down price. He gets the manufacturers bidding against one another, and of course they get the price as low as possible, and then make the silver plating as light as they can and do the burnishing in the shortest time, and of course the headlights do not last as they do when made in the shops of the railroad. Taking such points into consideration, there are some things a road can make much cheaper than they can get from outside parties.

Mr. Wattson—I should not wonder if the Grand Trunk was a case of proper theory, but the failure to work out any results that are satisfactory explains why there is some American blood going to run the Grand Trunk Railroad after the first of January. (Applause.)

Mr. Brangs—I think one reason why the railroad companies cannot compete with the general manufacturers is that in most all railroad shops the day-work principle is almost universally adhered to, while in most all large manufacturing establishments the piece-work principle is in vogue. I know, in my own experience, before I entered the railroad service, that an article, where it seemed almost impossible to get the prices down any lower, just as soon as we changed the system from day work to piece work, there was a revolution at once—prices dropped from 50 to 75 per cent. Apropos of Mr. Vreeland's remark about the trolley wheel which cost $3.50, very likely that was due to the fact that when they started they made only about a hundred at a time, and by the time he got his shop equipped they made five thousand where they formerly made one hundred. I believe that if the railroads

introduce the piece-work system in their shops they could manufacture as cheaply as the manufacturer. As to wanting to keep good men at work—the good men, when there is very little work in the shop, do very little work. (Laughter.) You cannot blame the men for that, for the reason that they want to keep the job, and the more sympathy you have the longer the man makes the job last. I agree with Mr. Wattson, that it is necessary to keep a certain force of men all the year round, but that does not answer the question under discussion, which is, "Does it pay?" and I would say most decidedly it does not pay, because you want to keep the men at work, because good workmen very soon find out that when work is very slow in the shop that they must make it last as long as possible.

Mr. Coolbaugh—There are three points that impress themselves upon my mind that have been touched on by these gentlemen. First, Why did the leading roads of the country, twenty-five or thirty years ago, manufacture their own material? At that time this nation was an agricultural nation. To-day it is a manufacturing nation. I believe that will account in a large measure for the fact that those roads which formerly manufactured for themselves have abandoned it and turned it over to the manufacturing concerns of the country. Another thing suggested by the remark made by Mr. Fowler, that along the line of the Grand Trunk road there is probably not a single manufacturing establishment—Who is responsible for that fact? The Grand Trunk Railroad. Had they given the manufacturers or any business men along the line of the road any encouragement to manufacture their nails, they could have been manufactured cheaper than the Grand Trunk can manufacture for themselves. If every railroad in the country becomes a manufacturing establishment, how long will it be before the manufacturing concerns that now dot the lines of their roads would be closed? I believe that the railway companies canot afford, on account of that broad principle alone, to continue, or engage, in manufacturing. Another thing, when a man compares himself with somebody who is precisely the same as himself, the result is that there is absolutely nothing gained—nothing in the way of a new idea. Now, I apply that in this way—that a manufacturer of anything entering into the equipment of

engines or cars presents not only the experience of one road, but the experience of all roads throughout the country. The article manufactured by a railroad company would be manufactured to-day just as it was twenty-five years ago, because the railroad has nothing in the world in the way of a new idea—nothing that has suggested itself by the experience of other roads. The question of specialties enters in here. The roads of the country twenty-five years ago were managed practically by one man. He had a knowledge of transportation. He had a knowledge of motive power. He had a knowledge of car construction and track work, and he was practically the manager of the road. To-day the railroads are managed by specialists. The traffic man plays his part, the superintendent of motive power plays his part,the superintendent of the car department plays his part, and the result is that we have an educated head for each of those departments. If you were in the market for a supply of matches, and there were two competing concerns, one of which made tooth-picks and matches, while the other made matches exclusively, you would naturally go to the man who made matches exclusively, because he would be a specialist in his line, and would make a better match than the man who made matches and tooth-picks.

Mr. Mendenhall read the report of the tellers on the ballot. The following officers were elected for the year 1895-6:

President—George W. West

First Vice-President—A. E. Mitchell.

Second Vice-President—H. H. Vreeland.

Third Vice-President—C. M. Mendenhall.

Treasurer—C. A. Smith.

Executive Committee—W. C. Ennis, W. G. Wattson, W. W. Snow.

Finance Committee—F. M. Patrick, R. M. Dixon, D. M. Brady.

The President—Members of the New York Railroad Club and Friends—I wish that words were at my command to express the thoughts that come to me on this occasion. Nothing I can say will serve the purpose better than to thank you, which I most sincerely do, for the honor of electing me as presiding officer over

so influential an organization as this New York Railroad Club. When we consider what it and the sister clubs of the country have done for the railroads in the past, and what the future possibilities may be, we wonder that any progressive man, interested in the welfare of his company, can absent himself from these meetings. Who can tell the number of delays to traffic that have been avoided or the dollars saved in operating through an exchange of opinions and experience brought about at these meetings. If the other railroads of the country have been benefited as the Ontario & Western have, I am sure none of our general officers will object to any of their officers or men attending these meetings. Our membership has been increased handsomely during the past year, and while we cannot say that the enthusiasm and the visible results have kept pace with the increased membership, I for one feel that there has been an awakening of the members and an interest exhibited among a class that has not showed itself in our open meetings. I refer now to the social features of our club. I know that I am not voicing the united opinion of all our members, but I could not help but notice in the past year, in talking with several of our members who seldom if ever speak in open meetings, the wonderful amount of knowledge and information that has been distributed among the members in the lunch room below. It may be a fact that all men are created equal, but it is equally a fact that they do not develop or mature alike. In my opinion there are two classes of intellectual men; those who are gifted with the power of speech, who can impart to the multitude any knowledge or information they have with an ease and grace that commands admiration. On the other hand, there are a few men, not the least among our members, who cannot express themselves in these open meetings, and members might have noticed in the year past groups of three or four people in the lunch room exchanging information, and, as I said, there has been a wonderful amount of information distributed among the members in the room below, and I for one am in favor of continuing those lunches.

There is one other thought and I will close. I would like to see the presidents of our railroads interested in these meetings, and I believe that if an invitation was given to some of them in

the future they would be willing to devote a few moments on one or two evenings of the year to show their good will towards these meetings. We have in our immediate vicinity President Thomas, of the Erie; President Depew, of the New York Central; President Layng, of the West Shore, and our own President Fowler, of the Ontario & Western, and I believe that any of them would be glad to say a few words to us, and I think that by so doing other officers of railroads would be induced to interest themselves in these meetings.

Thanking you again, gentlemen, for your kind attention, I would ask your further pleasure. (Applause.)

Mr. Mitchell—Gentlemen, I thank you for honoring me thus—making me an officer of this club. I think the President has covered more than I could say, and all I would add is that I second his motion. (Applause.)

Mr. Vreeland—Gentlemen, I am glad to have an opportunity once to express appreciation of an election. I have been elected President and Vice-President of so many companies in the last two years, and the minute it was done it was said, "We will now proceed to business," and I never got a chance to make a speech. Among the honors bestowed on me the last two years I can assure you I appreciate this as much or more than any of them; for those were in a business sense, while this is a club, and a club of such standing that the honor is very much appreciated by me.

Mr. Mendenhall—I have had to work pretty hard this evening, as teller, to be elected, or to elect myself, Third Vice-President. Gentlemen, I asure you I appreciate the honor.

Mr. Smith—Mr. President, I can only say that I thank the club for re-electing me Treasurer again, and I appreciate the compliment. I can only say there will be no change in what I do, but if, as someone said to me a short time ago, the Treasurer must furnish a bond, I would like to know who of you is going on my bond. (Laughter.)

Mr. Ennis—Gentlemen, I can only thank you for the honor you have conferred upon me.

Mr. Wattson—Gentlemen, on railroads we support our officers, and I think it is a pretty good doctrine to have in a club. Therefore I am with the President in seconding the motion for a continuance of the lunches downstairs. (Applause.)

Mr. Patrick—I will say, Mr. President, that the Finance Committee's report is always made in writing. I should be glad, however, to approve all the bills for the lunches, as I think it does more good by far, spending the money in that way, than in any other way, so long as we have plenty of it. (Applause.)

Mr. D. M. Brady—Mr. President, I thank the club cordially for my re-election, and I would like to say, that so far as the finances of the club are concerned, your humble servant has not had one word to say about them in the past year; so he deserves no credit. I want to say that the financial exhibit of the club made to-night is to me very discouraging and very unsatisfactory. The New England Club, which has not one half the resources to draw on that the New York Club has, have collected during the past year just twice as much money. I think we should have a good strong standing fund in the club, but we never seem, for some reason or other, to be able to gather it together. We always have plenty for our wants, though sometimes we are a little hard-pressed for money, and I think our balance, instead of being $1,200, ought to be $4,000 or $5,000. I do not know who is going to be Chairman of the Finance Committee next year. I have not the remotest idea. I know I was not for the last year; but I will say this, that if the members of the New York Railroad Club, of which I have been a member twenty-five years, are willing to trust the finances with me for one year, I will roll them up a good round balance to a certainty. I think we ought to take the lead. There is no reason why the Chicago Club or the New England Club or any other railroad club in the country should lead the Empire State. Further than that I have nothing to say, Mr. Chairman.

Mr. Patrick—In response to the remarks of Mr. Brady, I would beg to say that the Ways and Means Committee of this club is the Executive Committee. The Finance Committee has nothing to do with the obtaining of funds. Their duties are only to see that they are properly expended, and that the accounts of the Treasurer are correctly kept. (Applause.)

Secretary Hill read the following names passed on for membership by the Executive Committee:

Wm. D. Zehnder, Jos. Olhausen, W. Bryan, A. J. Beckley, Wm. L. Saunders, W. Sargent, C. H. McKibben, Geo. L. Weiss, Wm. T. Baird, Francis J. Hamilton, T. J. Mendenhall, J. C. Gibbons, W. B. McCaleb.

On motion the Secretary cast the ballot for all.

Mr. Parke—I believe that at the last meeting of the club a committee was appointed on the large car question. I do not know whether they have anything to report to-night—perhaps they have.

The President—Mr. Wheatley was chairman of that committee.

Mr. Wheatley—I have no doubt that if the committee had been called on for a report at the last meeting that they would have been all ready to make it, but since they have had a little time to consider the matter, they find they will want several months before they can complete this report—at least until the January meeting. If it be the pleasure of the club the committee would be pleased to have until the January meeting to complete their report.

On motion the request was granted.

Members present, 132.

The meeting adjourned at 10:20 P.M.

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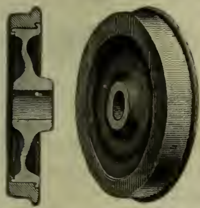

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New York Railroad Club.

Meeting of December 19, 1895.

SUBJECTS:

Balanced Slide Valves and The Allen Port;

AND

The Cause of Passenger Train Detentions.

Published by the Club.

W. G. WATTSON, SECRETARY, FOOT WEST 42D ST.

NEW YORK.

1896.

New York Railroad Club.

OFFICERS FOR 1896.

President,

GEORGE W. WEST,

Superintendent of Motive Power, New York, Ontario & Western Railway.

First Vice-President,

A. E. MITCHELL,

Superintendent of Motive Power, N. Y., Lake Erie & Western Ry.

Second Vice-President,

H. H. VREELAND,

President Metropolitan Street Railway Company.

Third Vice-President,

C. M. MENDENHALL,

Superintendent of Motive Power, Philadelphia, Wilmington & Baltimore R.R.

Secretary,

W. G. WATTSON,

Superintendent West Shore R.R.

Treasurer,

C. A. SMITH,

Master Car Builder, Union Tank Line.

Executive Committee,

W. W. SNOW,

President Ramapo Iron Works.

W. C. ENNIS,

Master Mechanic, New York, Susquehanna & Western.

SAMUEL HIGGINS,

Superintendent of Motive Power, Lehigh Valley Railroad.

Finance Committee,

F. M. PATRICK,

H. W. Johns Manfg. Co.

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Engineer, Safety Car Heating & Lighting Co.

D. M. BRADY,

Brady Metal Company

PROCEEDINGS

OF THE

New York Railroad Club.

Meeting held at the Rooms of the American Society of Mechanical Engineers, 12 West Thirty-first Street, New York, on Thursday Evening, December 19, 1895.

President West called the meeting to order at 8:15 P. M.

On motion the calling of the roll was dispensed with.

The Secretary read the minutes of the meeting of November 21st, which, on motion, were approved.

The President—The Executive Committee held a meeting to-day, and amongst other business, took action in connection with the election of a secretary. As Mr. W. W. Snow was made Chairman of the committee, I would be glad to have him state the results of the meeting.

Mr. Snow—I regret very much to state that our past secretary, Mr. Hill, who has served us four years, declined to serve the Club any longer. We passed suitable resolutions thanking him for his services to the Club, and after careful consideration we decided to appoint as secretary Mr. W. G. Wattson, who now sits in the secretary's chair. In addition to that, the Executive Committee appointed Mr. Higgins, superintendent of motive power Lehigh Valley R.R., as an executive member in place of Mr. Wattson.

The President—I would also say that while the Executive Committee extended a vote of thanks to Mr. Hill, it seems to me that we, as a body, ought to do something in recognition of Mr. Hill's valuable services to this Club.

Mr. Hill—Mr. President, if you will allow me a word before any motion is made—I do not believe this Club owes me any resolution of thanks. I have held an office here for which I was paid. Perhaps I earned my money; perhaps I did not. The Club certainly does not owe me anything. I had some satisfaction in the office for four years. I hope Mr. Wattson will have as much pleasure out of it as I had.

Mr. Forney—I do not agree with Mr. Hill.

The President—Nor I.

Mr. Forney—In these days, when we all find it so extremely difficult to get faithful service from people to whom we do pay salaries, I think it does not follow, because a man does receive a salary and has served an association or individual faithfully, that therefore a vote of thanks is not his due. I think the prosperity of this Club is to a very great extent due to the efforts which have been made by Mr. Hill. Some time ago I occupied a position upon the Executive Committee of this association for several years, and we worked very hard, and we did our best, but the Club languished. Mr. Hill succeeded us, and through his efforts the prosperity of the Club has grown to what it is now. I therefore think that a vote of thanks is justly due to Mr. Hill from this association for the skill, the care and the faithfulness with which he has administered the affairs of the Club, and I move that a vote of thanks be passed to Mr. Hill for his services. (Applause.)

The motion was carried unanimously.

The President—I would say for the benefit of Mr. Wheatley and the committee on the large car problem, that at the meeting of the Executive Committee to-day, the recommendation of Mr. Wheatley's committee was sustained and a sufficient sum was authorized for preparing a report of this committee in advance of the February meeting for distribution amongst the members.

Next in order is the discussion of technical subjects. The first in order is "Balanced Valves," on which Mr. Pomeroy will read a paper.

Mr. Pomeroy read the following paper:

Balanced Slide Valves and the Allen Port.

First :—*Balanced Valves*—The primary object in suggesting the subject of "balance valves and valves provided with Allen ports," was that we might have an experience meeting, and bring out some facts that would be of service to the committee appointed to investigate and report on the same subject, at the next meeting of the Master Mechanics' Association.

In consenting to open the discussion to-night, obvious circumstances necessitate the handling of the subject from the standpoint of the "man on the fence," and our remarks will be confined to a brief extract of what is already on record concerning the subject, as a background to the discussion to follow. In studying the question from the writer's standpoint, one is at once brought face to face with the fact, that the material on record is far from satisfactory, and when definite figures are given, they are open to question, owing to the "variables" in the problem.

If the members are moved to a free discussion of the *pros* and *cons* of the question, in the light of their valuable experience, the writer feels that the object of the meeting is fully met.

The first application of a balance valve to a locomotive was by John Gray, about the year 1838, on the Liverpool & Manchester Ry., to one of the engines used to "assist" on the Sutton and Whiston inclines.

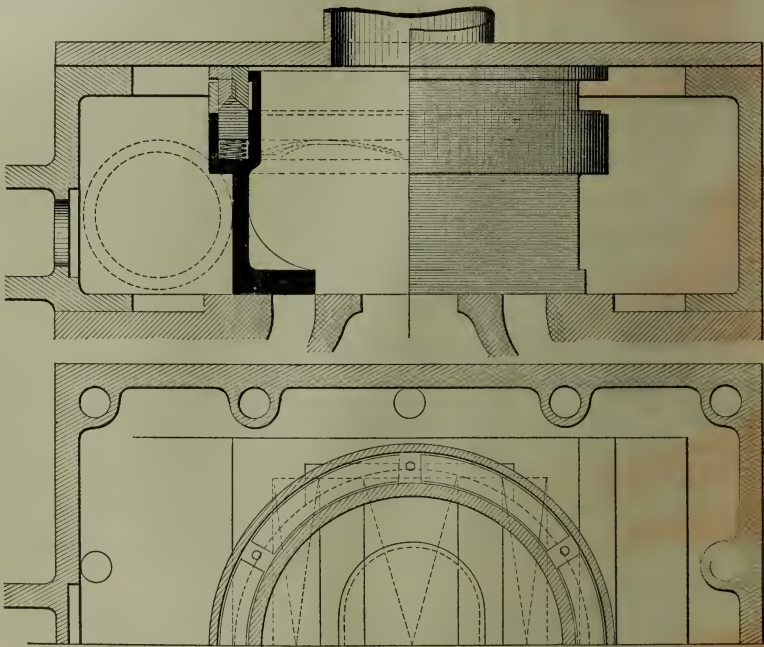
In the year 1844 there was in use on the Grand Junction Ry. (now a part of the London & Northwestern System) a form of balance shown in Fig. 1.

"The ordinary slide valve generally used in locomotives has the serious disadvantage that the pressure upon it when working is so heavy as to cause great wear of the rubbing face of the valve and valve seat, and the force expended in overcoming the friction, is a considerable loss of power, and involves serious wear of the valve gear and difficulty in reversing the action of the valve."

Unbalanced valves have been known to cut $\frac{1}{8}$ of an inch from valve seat in 100 miles run. (Testimony of a member in the 17th M. M. Asso. reports.)

The following quotation from tests made by Mr. W. G. Beattie (Proceedings Inst. of M. E., England, 1871) as to the need of relief from the load on top of the valve, is to the point.

The valve used in the tests (Figs. 2, 3 and 4) had 1 inch lap, and the area under pressure during that portion of the stroke in which steam admission takes place, which may be taken at one-third of



YEAR 1844 LONDON & NORTHWESTERN R. R.

Fig. 1

the stroke, extends from the edge of the steam port at *A* (Fig. 2) to the end of the cylinder port facing at *E*, or 10 inches long by 17 inches wide (of the valve over the flanges), or an area of 170 square inches under steam pressure for a 17-inch cylinder. During the remaining two-thirds of the stroke, after closing of steam port, the whole area of the valve is under steam pressure, or $10\frac{1}{2}$ inches long by 17 inches wide, equals 178 square inches in area; an average throughout of 176 square inches area, and this area,

at 125 pounds pressure per square inch, equals a total pressure upon back of valve of 22,000 pounds. From this pressure on back or top of valve, there must be deducted the pressure under the valve, exerted by the steam in the cylinder; and taking the exhaust to open at two-thirds of the stroke, this pressure under the valve will be in the first one-third of the stroke, that of the exhaust steam only, acting on the area *C D* of the inside of the valve (Fig. 2). In the second third of the stroke (Fig. 3), there will be in addition, the pressure of the expanding steam within the cylinder, acting upon the area of the steam port *A B;* and in the last one-third of the stroke (Fig. 4) there will be the pressure of the exhausting steam from the cylinder, acting upon the inside of the valve, with the addition of an average area of half the steam port, and also the pressure due to compression at the other end of the cylinder, acting on the area of the other steam port. From the results of indicator diagrams taken with the same pressure of steam, 125 pounds per square inch, at a speed of 20 miles per hour, these several pressures may be taken as follows, as shown in the approximate indicator diagram (Fig. 5). In the first and second thirds of the stroke, 5 pounds per square inch for the exhaust steam pressure; in the second third, 81 pounds mean pressure of the steam in the cylinder expanding from 125 pounds into double the volume, and in the last one-third of the stroke, 16 pounds mean pressure of the exhausting steam and 33 pounds mean pressure of the compression. The size of the steam port being $14\frac{1}{2}$x$1\frac{1}{2}$ inches, and the inside of the valve $14\frac{1}{2}$x6 inches, or 18 and 87 square inches area respectively, the total pressure under the valve amounts to 435 pounds in the first third, 1,901 pounds in the second third, and 2,133 pounds in the last third, or a mean pressure of 1,490 pounds throughout, and deducting this from 22,000 pounds pressure on the back of the valve, there remains an effective pressure of 20,510 pounds, or 9 gross tons upon the back of each valve.

For the purpose of measuring the actual power required to move the valves under these circumstances, the valve link mo-

tion was removed, and the valve stem was connected to a lever having the proportion of 20 to 1. From the extremity of the

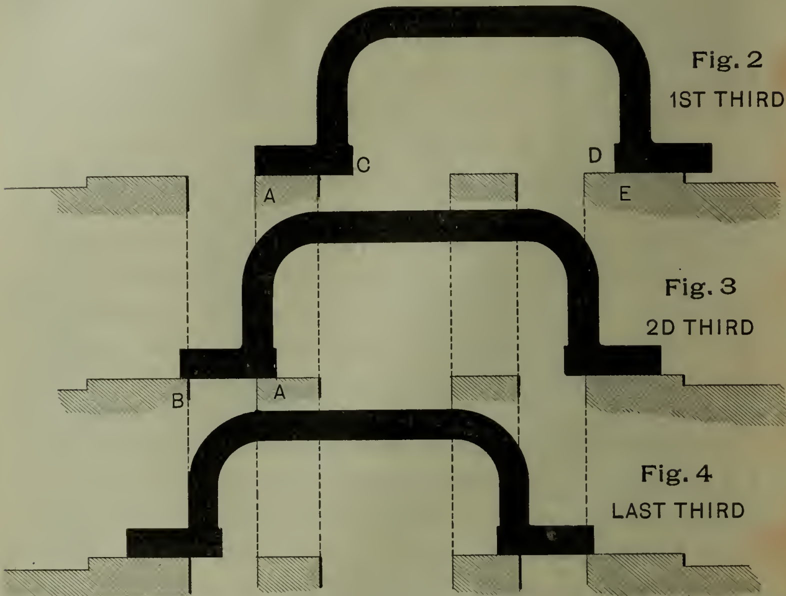


Fig. 2
1ST THIRD

Fig. 3
2D THIRD

Fig. 4
LAST THIRD

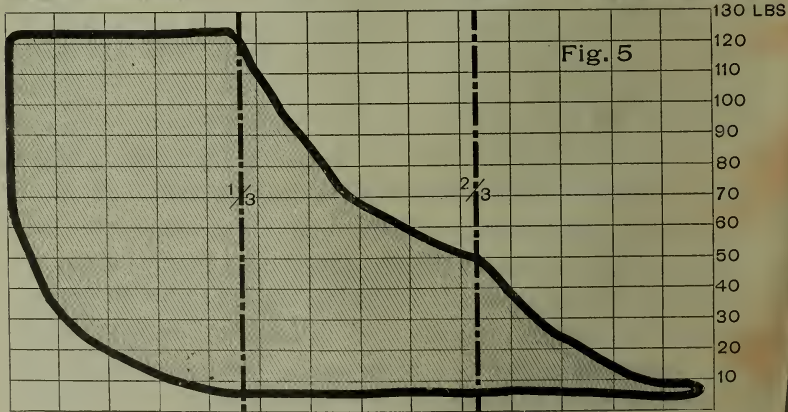


Fig. 5

lever a cord was led over pulleys to the front of the engine and weights were then hung on the cord until the valve began to move; a steam pressure of 125 pounds per square inch being

maintained in the steam chest. In the first experiment, which was several times repeated, the weight required to move the valve was 308 pounds, amounting to a force of 6,160 pounds exerted on the valve stem, or equivalent to the "friction of rest," *i. e.*, the greatest amount of friction possible under the circumstances, but as the motion of the valve when once started became rapidly accelerated, a smaller weight was applied and the valve was started by hand; the weight then required to maintain motion steadily in the valve was found, from several experiments, to be 231 pounds, or equivalent to a force of 4,620 pounds at the valve stem. Then taking the length of the stroke of valve to be 4 inches, and that of the piston 22 inches, the power required to be exerted at the piston to maintain the motion of the valve will be 4-22x4,620 pounds, equals 840 pounds. To this has to be added the power required to overcome the friction of the valve motion, rockers, etc., and this acts on a diameter of 14 inches, the proportionate force at the piston will be 14-22x4,620 equals 2,940 pounds, and taking the coefficient of friction to be 1-12 the power required at the piston, equals 1-12x2,940, or 245 pounds.

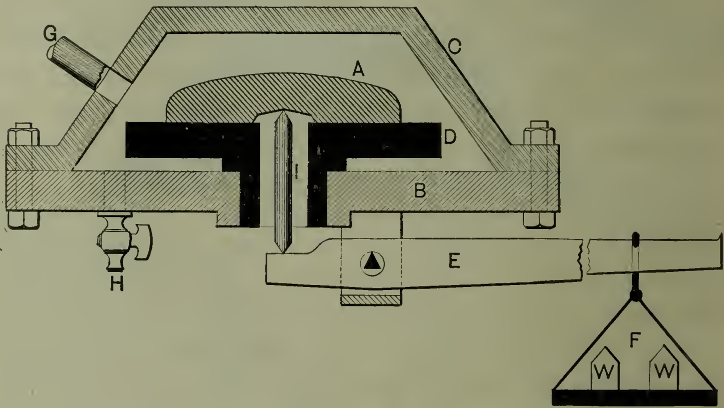
The total of the two resistances is equivalent to a force of 1,085 pounds at the piston, the diameter of which is 17 inches; this is a constant deduction of 5 pounds per square inch from the effective steam pressure upon the piston, or a loss of about 8 per cent.

On the question of "effective area" to be balanced, the experiments of Prof. Robinson (Proceedings of the Am. Soc. M. E., 1883) are of interest A model was constructed (Fig. 6), and is described as follows:

Plates *A* and *D* had their surfaces fitted together by grinding until a good contact was made. *C* is an enclosing chest to which steam was admitted through pipe *G*. Lever *E* is a scale beam to weigh the force required to lift plate *A* from its seat. Cavity under Plate A to represent the exhaust cavity in a *D* valve. Experiments made at varying pressures from 5 to 90 pounds per square inch, showed that the pressure of the valve upon the seat was much greater than the product of the area of the cavity

under the valve multiplied by the pressure above it, and yet the pressure holding it down was not as great as the total area of plate multiplied by the pressure. Plate *A* equals 6 inches in diameter, and cavity under plate equals 2.1 inches. With a pressure of 75 pounds per square inch in the chest and atmospheric pressure under the cavity, it took 787.5 pounds to balance the plate upon its seat. At 75 pounds pressure per square inch it would require an area of 10.5 square inches to balance the valve; that would require a circle of 3.7 inches in diameter. To make it more plain, suppose the pin *I* was prolonged downward, terminating in a piston 3.7 inches in diameter, fitting into a cylinder; it would

Fig. 6



require a pressure of 75 pounds per square inch to balance the valve. The visible cavity under the valve is only 2.1 inches in diameter, therefore it is plain that the "effective" cavity is much larger. The 3.7 inches diameter in the case cited would be what Prof. Robinson calls the "equillibrium area," because that area is what would be required to balance the valve, if acted on by the same pressure per square inch which is in the chest. The "equillibrium area," of course, varies with the steam pressure. Prof. Robinson is a believer in the theory of an imperceptible film of

steam between the valve and its seat tending to separate them, when acted on by steam pressure.

(Note—Mr. Beattie places the coefficient of friction as 0.083, Prof. Robinson at 0.10, and Mr. Aspinall at 0.068.)

Tests were also made by Philip Wallis, 1886, while Engineer of Tests on the C., B. & Q., from which he concludes that six horse power is required to work the unbalanced valves at 40 miles per hour, while for the balanced valves 2.2 horse power only would be necessary.

The unbalanced valves used had a surface of 164 square inches exposed to a steam pressure. The balanced valves had an unbalanced surface of 96 square inches. The following table gives the results of the tests:

Balanced Valve.				Unbalanced Valve.	
Cut off, Inches.	Speed, M. P. H.	Boiler Press.	Valve Resistance.	Boiler Press.	Valve Resistance.
5	20	135	463 lbs.	140	724 lbs.
8	20	135	337 "	135	848 "
8	slow	135	. . . . . .	135	887 "
11	slow	135	294 lbs.	135	877 "
11	20	135	313 "	135	877 "
14	slow	135	462 "	135	867 "
14	20	135	337 "	135	901 "
17	slow	130	434 "	135	1078 "
17	20	135	284 "	135	940 "
20	slow	135	265 "	135	949 "
20	20	130	217 "	140	911 "
22	slow	135	274 "	140	930 "
22	20	135	279 "	135	930 "
Average...	. . . .	133.3	330 lbs.	136	905 lbs.

It is claimed that the engine used in Mr. Wallis's tests had only 40 per cent. of the area of the face of the valve balanced, whereas 60 per cent. of such area has been successfully used. It is therefore obvious that better results would have been shown had the valves of the engine in the "Q" tests been balanced more nearly up to the limit.

From the foregoing we find that the balanced valve offered but

$36\frac{1}{2}$ per cent. of the resistance offered by the unbalanced valve for practically the same boiler pressures, and the lubrication was continuous in both cases.

In pursuing our inquiry we encounter three classes:

First—Those who recognize the necessity of balancing the valves;

Second—A large class who claim that the "D" valve is good enough, and

Third—Those who recognize the necessity and proceed at once to evolve or invent one for the occasion, and in consequence a great many of the "alleged" variety have come and gone, which have been fearfully and wonderfully made.

The following (Figs. 7 to 14, inclusive) represent some of the different types that have appeared on the scene and have finally receded from view. Besides these, there has been an infinite variety of the "balance strip form" similar to the Delancey, Morse and Richardson, and this is quite true of the "balance ring types" and the "survival of the fittest" has resulted in the well-known "Richardson" and "American" valves, the former, perhaps, being the best known. The thin, rectangular frame valve with pressure plate is not much distorted by pressure or heat, from the fact that the valve is free to expand both in length and width, without touching anything, and it is thin enough so there can be no harmful variation of thickness from unequal expansion. The pressure plate is made heavy enough to withstand the pressure without changing its form, and is shaped of as uniform section as possible, so that expansion due to heat will not distort it.

A rule that gives results that come well within the maximum amount that experience has shown to be practical (*i.e.*, 60 per cent. of the total area of the face of the valve) is as follows: For an ordinary plain slide valve; area of exhaust cavity, plus one steam port.

EXAMPLE:

Total area of valve ($19'' \times 8\frac{7}{8}''$)	$=$ 168.625	square	inches.
Area of 1 port ($1\frac{1}{8}'' \times 16''$)	$=$ 18.	"	"
Area of exhaust cavity ($4\frac{7}{8}'' \times 16''$)	$=$ 78.	"	"

And $78 + 18 = 96$ square inches $\frac{96}{168.625} = 56.9$ per cent.

In going over the "history of the art" one cannot help being led to conclude that any form of balance that consists of a solid frame is not satisfactory for the reason that the wear is not uniformly

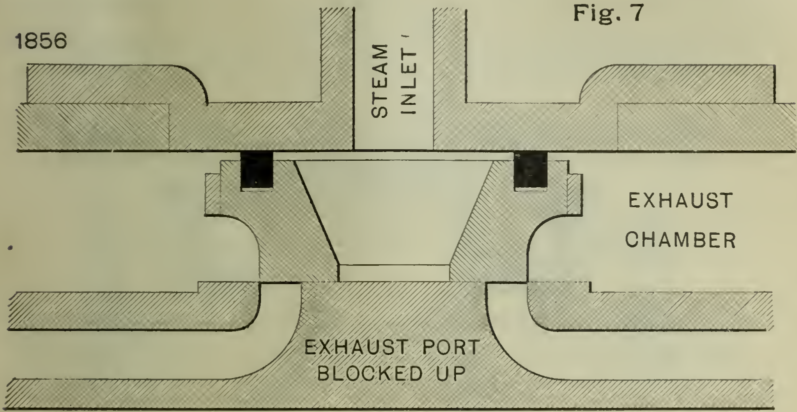


Fig. 7

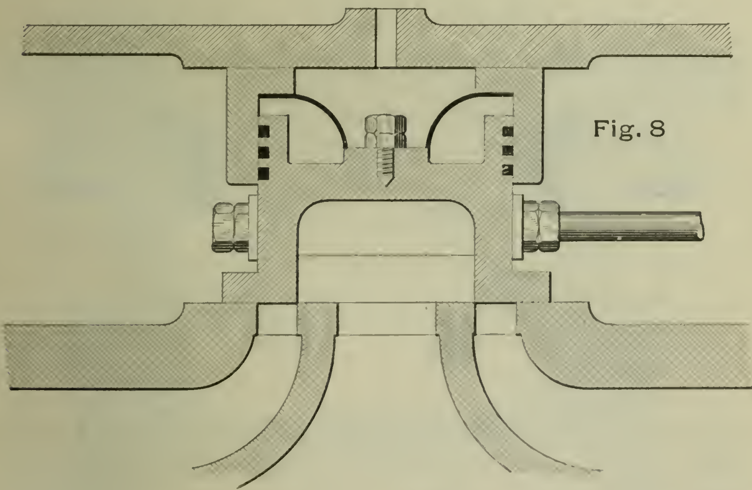
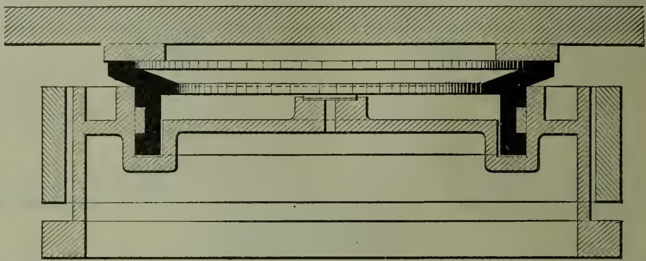


Fig. 8

distributed over the bearing surface, that is to say, certain parts will wear more rapidly than others, thereby causing a "blow," whereas a sectional packing, that will admit of each piece having

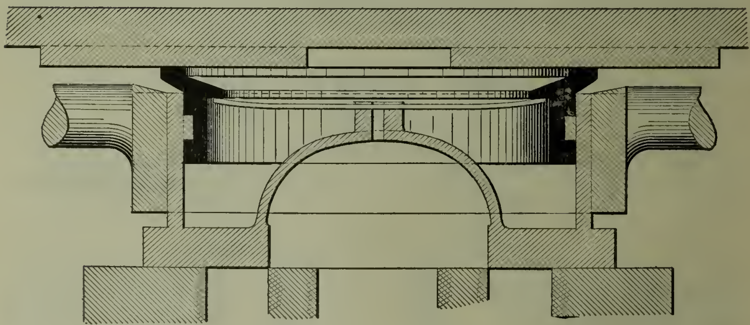
an independent wearing surface, not traversed by any of the other sections, will fulfil the requirements.

There are two features in the construction of the piston valve that enable it to be made one of the most perfectly balanced valves that can be constructed. The cylindrical walls that enclose it, and the same shape for the valve make it the best form to get a



ADAMS ON GT. NORTHERN, SCOTLAND.

Fig. 9



uniform expansion of the metal due to heat and with the least weight of metal gives the greatest strength to withstand the distorting effect of steam pressure. Piston valves in marine service have long been a success; being arranged to work vertically they have not the same difficulties to contend with as in locomotive practice, where they are worked horizontally.

Fig. 10

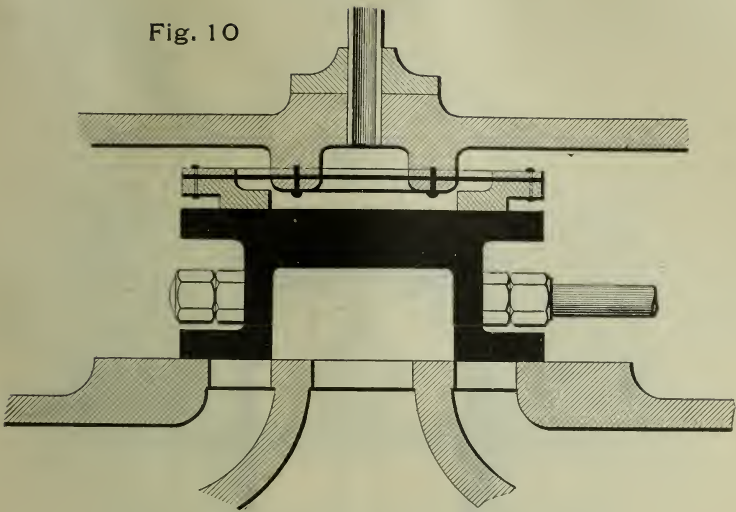


Fig. 11

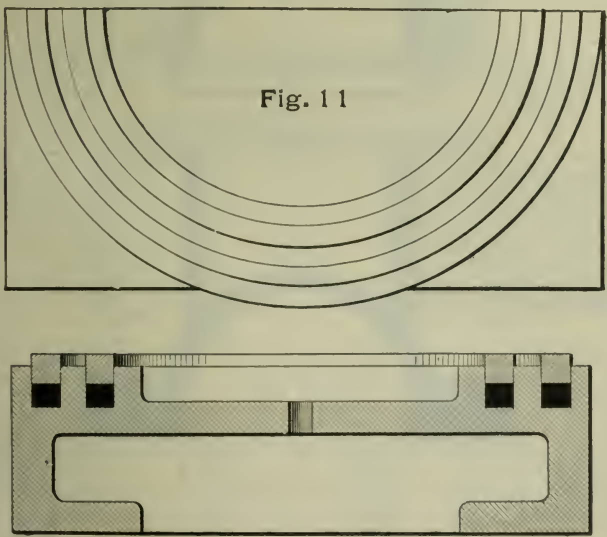
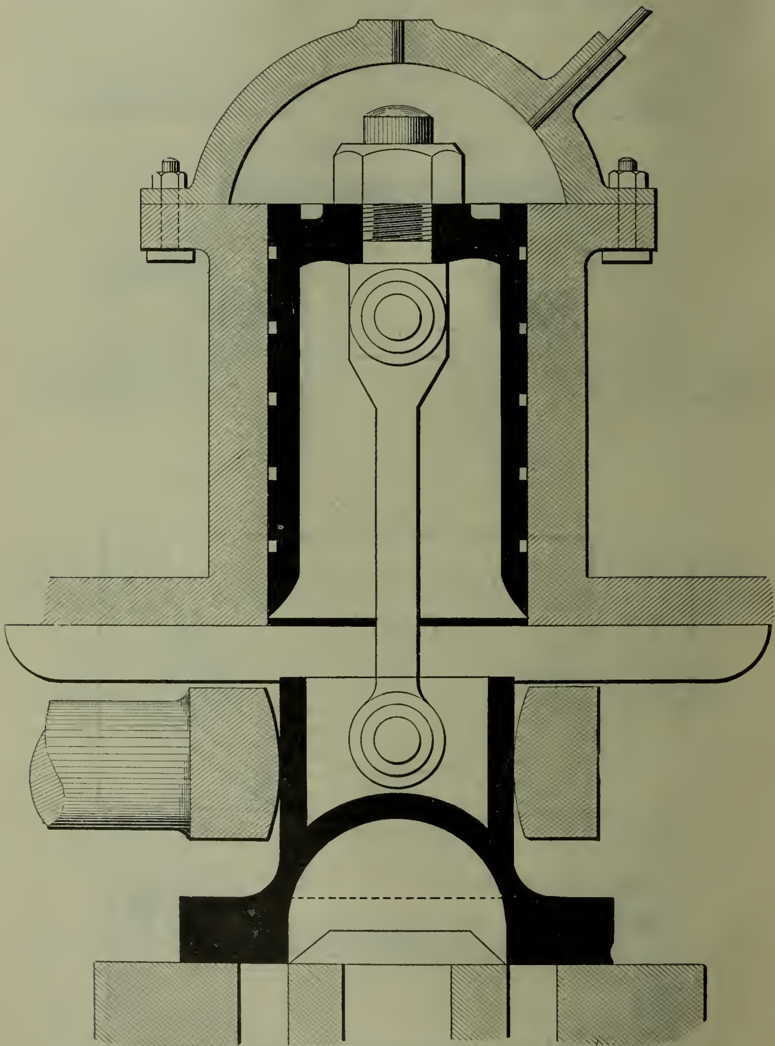
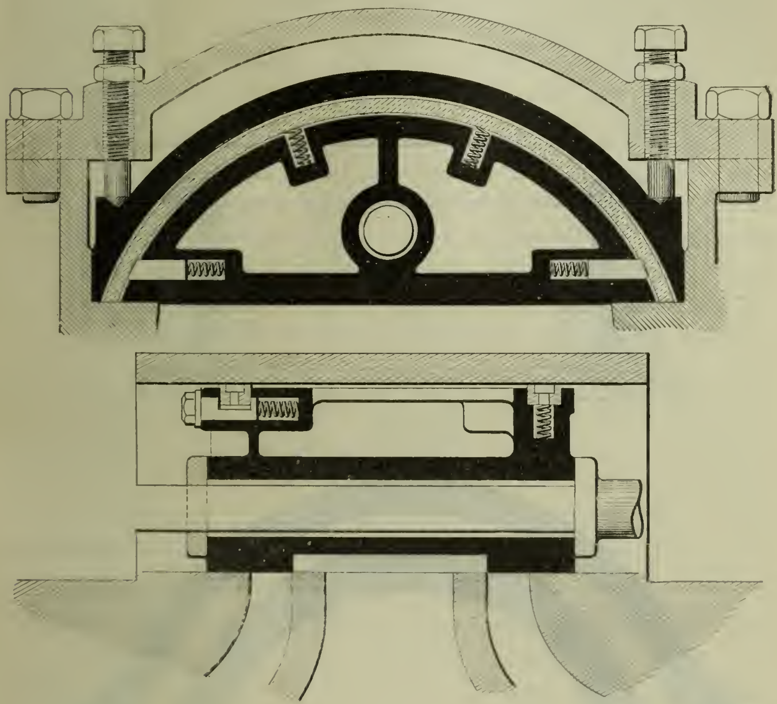


Fig. 12



Second :—*The Allen Port*—The object and claim of the advocates of the use of the "Allen Port" is that by its use a larger area is provided, through which steam may enter the cylinder, securing a higher average cylinder pressure, hence more power at a given cut off, and greater range of expansion.

Fig. 13



The most valuable material on the value of the "Allen Port" accessible to the writer is found in the paper of Mr. C. H. Quereau before the Western R.R. Club. He says: "The Allen port always leaves its distinguishing mark on cards, from single expansion locomotives. The wavy compression line is its sign manual," and is explained as follows: Fig. 15 shows Allen valve in such a position that cut off has just taken place in end *B* of cylinder.

The exhaust opening is almost closed and compression about to begin in end *A*. Under these conditions both openings of the

Fig. 14

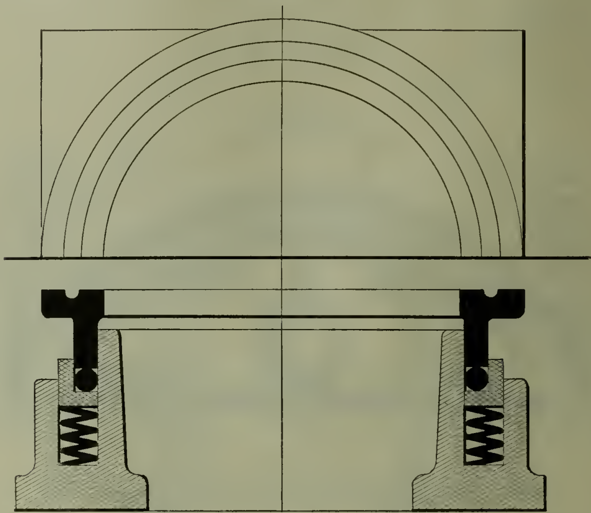
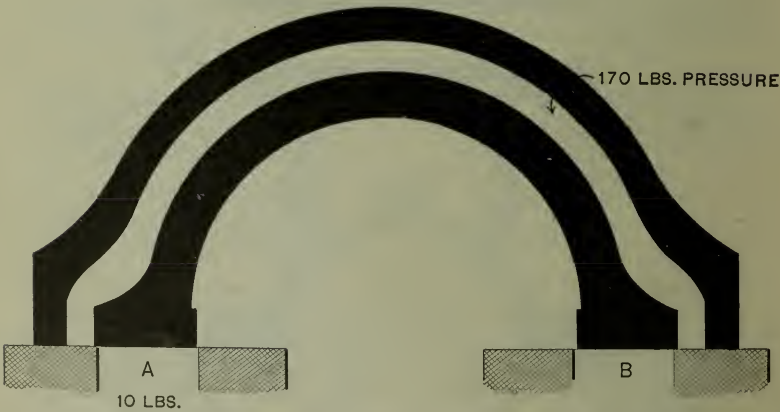


Fig. 15



Allen port are covered by the valve seat and the cavity is filled with steam at nearly boiler pressure, say 170 pounds. As the valve is moving toward the right, just after compression be-

gins in the end *A*, where the steam is at exhaust pressure, perhaps 10 pounds, the steam in the Allen port cavity will expand into port *A*, suddenly raising the pressure in that end and giving the indicator piston an impulse which will cause it to vibrate till lead opens, imparting to the compression line the reverse curves to which attention has been directed. "It is obvious that the greater the cubical contents of the Allen port cavity, the more pronounced are the reverse curves in the compression line." We are lead to conclude from the tests cited that the same results reached by using the Allen port were obtained by increase in travel of valve, as increasing the valve travel increases the mean effective pressure by giving a greater port opening for both admission and exhaust. Mr. Quereau says:"In coming to a conclusion in the matter, it should not be forgotten that the Allen port enlarges the steam opening by the same number of inches for all points of cut off, while a longer valve travel enlarges it a certain per cent., the number of square inches decreasing as the cut off grows shorter." Mr. Quereau further says, concerning lead: "If 1-16 inch lead at full gear is the best plan for a plain valve, about half that amount will answer the same purpose if the valve has an Allen port. If ½ inch lead will answer for a plain valve, at 6 inch cut off, ¼ inch will accomplish the same end with an Allen valve. The effect of this reduction of lead is threefold. It changes the cut off for a given notch in the quadrant, and delays both the point of exhaust opening and closure. By using the Allen valve and reducing the lead, the steam is expanded somewhat further and compression begins somewhat later, as is done by a longer valve travel. Cards taken from same engine with same valve motion except a change in lead, shows ¾ inch later exhaust opening, 1 inch later exhaust closure and a consequent gain of 5.2 pounds mean effective pressure, nearly 7 per cent., due to smaller lead necessary for an Allen valve. It would be very difficult to show from indicator cards that the effect of reduced lead held good at high speed because of the difficulty of locating exhaust opening and closure, but there is little doubt that there is a similar effect,

but the gain would not be as great a per cent. as at slow speeds."

We must conclude, First, that so far as the records go, it is highly advantageous to relieve the excessive pressure on top of the valves by some of the well known forms of balance devices, and Second, there are advantages to be derived from the use of the Allen port, although we must admit we find no figures that establish this latter point from the "standpoint of the coal pile."

Mr. Blackall—Mr. President, I move that the paper be received and placed on the minutes and that we now discuss the same.

The motion was carried.

Mr. Lewis—We have all sorts of balanced valves, from the plain D valve to the piston valve and the Richardson, both the plain balanced and also the Allen port valve. The latter we use exclusively on our passenger service engines, and are very much in favor of it. We get very good mileage out of some of them—say on an average from thirty to forty thousand miles—without taking out the valve. I would like to ask Mr. Muir if he can recollect the mileage of Engine No. 25. It was something like two years and two months before it was necessary to take out the valve on the engine.

Mr. Muir—It was two years and a little over two months.

Mr. Lewis—That is the Allen port valve, Richardson balance, and I am very much in favor of it. For our service—we have very hard service—they have to run the engines ordinarily wide open.

The President—Do you find the Allen port as advantageous in freight as in passenger service?

Mr. Lewis—No, not so much; because we cannot get the travel to get the starting point on a heavy train. But in passenger service we find it is beneficial. We find on an average, during the stroke, about 80 to 85 pounds of steam, where we cannot get with a plain valve more than 65 or 70. So you see it is a benefit all around; and as for the seats, there is no trouble with them at

all, and they go along from the time they go out of the shop until they come back again, and it is a very important item in the line of repairs.

Mr. Montgomery—I have listened to the reading of the paper with a great deal of interest. I do not think there is any question but that experience with the balanced valve has demonstrated the fact to railroad men that it is a great advantage in the matter of valve wear, and also wear upon the valve motion and eccentrics with larger sized engines or where there is a large pressure on the valve. With smaller engines, perhaps 16 inches or below, we may get along with the ordinary D valve. I have seen engines that have run twenty years with a seat $\frac{3}{4}$ of an inch high, and I have seen others an inch high that were cut down to the surface of the steam chest joint in five years, which shows that there is a great deal in the matter of the quality of the iron that is used in the cylinders and also in the valves in regard to the friction which causes more or less wear. But experience and investigation have demonstrated beyond a doubt that the balanced valve increases the efficiency and power of an engine as well as reduces the wear and tear, to what extent the paper has set forth.

I have read recently that in some new engines turned out on the C., B. & Q. road, they adopted the piston valve and increased the port area very materially. That was done with the view of decreasing the usual loss of power and improving the advantage of the balanced valve over the old slide valve. Of course there have been different methods of balancing valves, and some have proved useless. There is some loss of steam, perhaps, in the strips and from other causes. But the advantage that has been gained by the use of the valve in increasing the power and efficiency of the engine and saving the valve gear, has more than compensated, in the opinion of most men who have any experience in the matter, for the loss of steam.

The President—Is it not a fact that outside of the benefits to be derived from the valve face that we have less frequent breakages of the valve motion, links and eccentrics with the engines

equipped with the balanced valves than we formerly had with the unbalanced valves?

Mr. Mendenhall—It may be interesting in that line to state that at one time the friction was so great that it was necessary to move the valve with a mechanism, and steam reverse levers were put on a number of locomotives in the country for that purpose. With the introduction of the balanced device those were gradually removed from service, and the engine runners were able to reverse their engines or use their levers with one hand, easily with two hands, showing the less friction and less work required by the valve rigging with the balancing device. I think that is evidence that there is much less wear and tear on the valve rigging with the balanced valve. But it would seem that we are now gradually drifting toward the original condition. We use compound locomotives and we are necessarily increasing the weight of the valve very much, and that weight alone makes it almost necessary to do something to enable a runner to handle the valve.

Mr. Angus Sinclair—Mr. President, I have been for a great number of years very keenly interested in the balancing of valves or in doing something to reduce the immense friction that results from the pressure of steam on the one side and the friction of the surfaces on the other. There are, perhaps, not many here who remember the investigations that were made by the American Railway Master Mechanics' Association about twenty years ago in regard to balanced valves. The thing was gone into very thoroughly at the time, but the valves then were all very small and the pressure from below, during the exhaust period, was so great that the valve really did not cause a great deal of friction from the pressure from above; and if I remember rightly, the conclusion of the Master Mechanics' Association was that balancing was not necessary; that is with a valve about 12 inches long, which was about the maximum at that time, the exhaust cavity, with its pressures from below, had so much a balancing effect that a special balancing above was scarcely necessary. A great many devices had been tried, but there were certain imperfections

in the mechanical arrangements that made them unsatisfactory. They cut all the upper part of the plate where the steam was to be prevented from entering, and a great many mechanical difficulties were encountered, so that a mechanical expert declared about that time that the balancing of valves was an illusion and a practical impossibility. It was only when a mechanical genius, Mr. George Richardson, introduced a very simple arrangement, which made what was a failure into a success, that the balanced valves became worthy of the attention of railroad men.

About the time that this was done the valve began to be increased in area; cylinders were made larger; ports were made longer; the valves were made larger, and consequently it came to be a necessity, if you were going to keep your engines running a third of the time, that some method should be employed to reduce the tremendous wear that the valve seats were subjected to. In 1884 I was talking to Mr. Woodcock, the late superintendent of motive power of the Jersey Central. He told me that before he applied the balanced valves he had to face the valves of his fast engines every six weeks, and after he applied the balancing device they were able to run from nine to twelve months; consequently any one who has had experience of that sort is liable to make the best of a device that is going to save his repairs to such an extent. Within the last month I made a long tour in the West, and met many railroad men, master mechanics and others, and we got talking about the various appliances that had reduced the repairs to locomotives to the greatest extent within the last five or six years, and a most intelligent master mechanic, in charge of a large shop, a man who can see the advantage of any improvement as keenly as any man in the country, said to me, "We are using now a great many false valve seats on our engines. They are a nuisance; there is no end of trouble with them. If we had introduced balanced valves when you and I were foremen of the shops, we would not have a false seat on the road." I think that was the very best testimony in favor of balanced valves that I ever heard.

Mr. Medway—Mr. President, our engines are all equipped with the Richardson balanced valve. That valve has certainly given us very good satisfaction. I have no definite data as to the relative value of the balanced valve and the unbalanced valve. But from general observation I know that the balanced valve is preferable. We can prove that by noting the pull on the reverse lever when the balance strip or spring is broken. I think that on modern locomotives with a large valve area and high steam pressure, the unbalanced valve is out of the question. In reference to the balancing of valves, I understood Mr. Pomeroy to say that the Baldwin people took 56.5 per cent. area.

Mr. Pomeroy—I said it was that on a particular Baldwin engine that I took the dimensions from. I do not know what they use.

Mr. Medway—I was wondering how they get so high a balance as that. Our rule is 52 per cent. of the entire valve surface. As an experiment, on our last two engines, equipped with Allen-Richardson valves, I increased the balance to 55.4. I am of the opinion, however, that the balance is a trifle too high, from the fact that at the moment of starting the engine there is a decided blow through the exhaust pipe. That is evidently caused by the excessive overhang of the valve when at its greatest travel.

The President—Mr. Hammett, could you tell us what was the area of the balance of the last locomotive you furnished?

Mr. Hammett—About 55 per cent.

Mr. Medway—I would say right here, to prevent misapprehension, that we measure the balance from the inside of the strip. Is that right?

Mr. Hammett—That is correct. It should be measured from the inside. That is the area that is excluded from the pressure.

The President—Do the valves that you use have the Allen port?

Mr. Medway—The ones that I referred to last had the Allen port.

The President—Have you noticed any difference on your freight engines between Allen and Richardson valves?

Mr. Medway—The freight engines have a little less balance.

The President—Is there any advantage in the Allen port on freight service?

Mr. Medway—We do not use the Allen port on freight service. With regard to the Allen port, it is known to have an advantage in steam admission, but no particular advantage as to release. In view of this difficulty, we increased our auxiliary port to $\frac{5}{8}$ of an inch wide. The engines do remarkably good work at short cut off and high speed.

Mr. Blackall—Mr. President, we have used a very large number of false valve seats, and we began to apply the Richardson balanced valve. We have a locomotive, No. 210, which has been running with the same Richardson balanced valve for six years. Before that the valve seats wore off pretty rapidly.

Mr. Errickson—As Mr. Pomeroy stated, I was one of the first that ran the Richardson valves on our road. We got engines at that time on the New Jersey Central road which were the largest passenger locomotives in the world. The increase of the port area was so great that no man living could handle one of those engines with the valve open. If you wanted to hook them up you had to shut them off. The result was with Engine 164, we had to face her valves every thirty days, making 150 miles a day. After the Richardson appliance was put on, that engine ran fifteen months, and the valve was taken up without any perceptible wear. While twenty years ago it was not absolutely necessary to have a balanced valve, it would have been a benefit even at that time. To-day it is absolutely necessary, because you are carrying higher pressure.

It seems to me that some of the gentlemen are reckoning with pressure on top of the valve, and in my estimation that is a wrong point of view. I claim that the pressure on top of the valve is only equal to the square inches open under the valve. It would not make a particle of difference if your valve was three feet square, except the difference in weight of the valve, which is a trifle alongside of the pressure applied to it. If the ports under it were no larger the valve would move just as easy. Now we have got the

large ports open; that has increased the pressure on top of your valves, and the balanced valve has become a necessity. There is no gentleman having to do with locomotives to-day who can say that we can get along without a balanced valve. If it is a piston valve—of course, that is the finest valve we have got. But that valve is expensive, but the Richardson balance is cheap. I am running a locomotive to-day which I have run 80,000 miles since she was overhauled, and the valves, to all appearance, are in perfect working order. She will have to go in and have her tires and some other work done on her, but her eccentrics and links are just as perfect as at first, except the natural weight coming on to it. That engine, carrying 160 to 190 pounds of steam, with 19-inch cylinders and the large port necessary, could not possibly be handled without the balanced valve. If I break the spring in one of those locomotives, I have to go and have it fixed at once. There is another device that is used now—a movable adjustable plate on top of the valves, and I believe, as long as we are speaking of this thing, it is a good thing to bring up. I think the Richardson had a solid plate, or the steam chest dressed down.

Mr. Hammett—Planed down, giving the distance about 1-16 of an inch.

Mr. Errickson—There never ought to be more. I think this is patented by some other gentleman. It applies to the Richardson patent. This plate you can regulate to suit yourself. As your valve becomes half worn, you necessarily lower the valve, and you have to plane off the plate. If you leave the space too great, say $\frac{1}{4}$ of an inch, or $\frac{3}{8}$ of an inch, the pressure alongside of those gibs will blow them down, and you will get a decided blow on the start, because it blows over the gib and down through the opening in the exhaust. We have some of those engines, and we have at times to plane off the steam chest. It is not advisable to do that, because the time will come when you will want a new valve, and when you do want a new valve you have either got to plane that valve away or get a new steam chest; so with the adjustable

plate on top—as your valve wears down you simply regulate it down to the gibs the proper distance, and it runs along any length of time. I believe it would pay to balance every single valve; it doesn't make any difference how small it is. If it is absolutely necessary to balance large valves, it is certainly a benefit to balance small ones.

Mr. Minshull—With regard to balanced valves we had ten engines; five had the balanced valve and five the unbalanced valve. Those with the unbalanced valves gave us trouble on account of broken valve stems. That is something that never happens with the balanced valve.

With regard to the movable plate, we had engines with the balanced valves, and those plates on for the last twelve years. We call it a pressure plate, and when it is necessary to face your valve, we insert a washer between the steam chest and the balanced valve and the valve that we originally put in. The engineer says he finds it a decided advantage in the handling of the engine. He ran the engine for several years past, and says that since that has been put in the engine is handled much better than before. So I do not think there can be any question with regard to the advantage of the balanced valve.

Mr. Forney—I do not know much about balanced valves, with respect to the practical use of them. I remember that as long ago as twenty-five or thirty years, the subject was being investigated, and I recall some experiments that were made on the Illinois Central road about that time to determine the question of the relation between the pressure on the valve and the size of the opening under it. We took a plate and put it on the valve seat, without any holes in it, just similar to a false seat in a steam chest. We then took another plate of the same kind just equal to the size of the valve, and ground the two together, so as to make them as near perfectly steam-tight as possible. When we did that, and let steam onto the steam chest, the valve stem, which was detached, slowly moved at the stuffing box, showing that the pressure on the area of the valve stems was sufficiently great to

move that plate in the steam chest; showing that practically under those conditions there was no pressure on the valves at all. We then drilled a $\frac{3}{8}$-inch hole into the bottom of the plate, and when we did that it was with the greatest difficulty that we could move the plate at all. We then gradually increased the area of the opening below until we got it to approximate somewhere to the steam and exhaust ports below it. But the pressure on that plate increased very slightly in proportion to the size of the opening. So that the conclusion which we drew from that was that it made very little difference as to what the size of the opening was below the plate; that just the moment we put a hole there of any size at all, we got the pressure pretty nearly equal to the full area of the valve. We fitted a spring balance to the valve stem and made an attempt to measure the pressure or the strain required to move the plate; but the strain was so irregular and the resistance was so irregular that it was impossible to draw any deductions at all, and the conclusion we drew was that it made no difference what the size of the opening was; if there was a hole there at all it brought the whole steam pressure on it. At that time, of course, the balanced valve had not reached the conditions of perfection that it has now attained. It seems as though it was one of the greatest improvements made in locomotives. It is one of those curious cases in which all the advantages *are* advantages, and there seem to be no drawbacks to them. In the first place, it increases the amount of effective work which a locomotive can do, because it lessens the amount of power consumed in moving the valve. In the next place, it lessens the amount of the wear of the valve in its seat. Next, it lessens the amount of wear in the valve gear; and, lastly, it lessens the amount of wear in the muscles of the engineer, which is a matter of some importance, perhaps. So that, altogether, in view of the fact that the size of the valves is gradually being increased, and the pressure of steam is gradually being increased, it seems that it would be almost impossible to run locomotives at the present time without balanced valves. The Allen port valve has been spoken of here this evening. I remem-

ber some years ago when the valve was first brought to my attention, and it had then been before the public for so long a time that the patent was just about to expire. I called attention to what seemed to me to be the value of that invention, in a paper with which I was connected at that time, and afterwards I took the liberty of putting it in a little book to which my name was attached, and it seems as though the merits of that valve were made known to the railroad public of this whole country by that means; in other words, the merits of this valve, which had been before the public long enough to have the patent expire, had not been recognized until sombody took the trouble to point it out. Since then it has been introduced very generally, and I believe that the general testimony of master mechanics is that for fast running engines it has very decided and very great merits.

Second Subject: The Cause of Train Detentions.

The President—I will ask Mr. Mendenhall to open the discussion on the cause of train detentions.

Mr. Mendenhall—In the opening of this discussion it occurs to me that the first thing to bring to your attention is the extent of the trouble from train detentions, and, in going over it pretty thoroughly, I have concluded that there are four general heads under which it may be divided. But first I had better say something about the percentage of delays, and I think if any of you will take the trouble to work up your records, you will find that approximately 34 per cent. of your trains will arrive at their destination late. By late I mean within one minute of the schedule time. That record will vary, from the favorable months, say June, July and August, through to the winter months, which seem to be the most unfavorable. The schedules throughout the country are made so that the locomotives drawing trains can make up more or less of this lost time, and that also will vary with the conditions of the weather, the most being made up in the summer months, and I think the average, covering a pretty large train service, will be found to be in the neighborhood of

some eight minutes per train. I will call your attention to this table, which I have put on the blackboard:

Causes of Passenger Train Detention.

$89\frac{3}{10}\%$	Arbitrary: Traffic. Operation.		
$10\frac{7}{10}\%$ Equipment.	Engines, 55%	Hot Journals...	33%
		Hot Eccentrics.	3%
		Steam Failures.	24%
		Brake Failures..	13%
		Taking Water..	5%
		Couplers, Injectors, Steam Heat, Markers,	5%
		Miscellaneous ..	17%
			100%
	Cars, 45%	Hot Journals...	48%
		Brakes...... ..	38%
		Steam Heat....	4%
		Parting........	5%
		Miscellaneous...	5%
			100%

Now as to the causes of detentions—they may be divided into Arbitrary Detentions, those due to Traffic, and Operating, and those due to the Equipment. I am not able to give you any definite measure of the relative detentions of the first three, but I will say that you will probably find 89.3 or 89.5 per cent. of the train detentions due to the first three, and those due to failures of the equipment will be approximately 10.5 per cent. of the failures to your train service.

Then passing on to the failures on account of the Equipment, it will be found that 55 per cent. of those failures are due to locomotive failures, and about 45 per cent. to failures in the car service or on the cars. Locomotive failures may be divided into hot journals, eccentrics, etc., steam failures, brake failures, taking water, couplers, injectors, steam heat, headlamps, markers, as the headings which can be classified, and there are hardly enough of the last four which I have mentioned to make it a subject of classification. Then will come the miscellaneous failures, whatever

they may be. In the car failures there are hot journals, brakes, steam heat, parting, then the miscellaneous, and I have added at the extreme right about the percentage of failures due to the various parts.

I would say that under Arbitrary detentions may be mentioned those due to drawbridges, railroad crossings, grade crossings, conditions of the track due to working, change of track, etc.; and under the head of Traffic may come the heavy passenger travel, slow movement of the people, at times like these, when there are an unusual number traveling; the handling of an unusual amount of express baggage and mail; and under the head of Operating may be mentioned the disturbance to the freight movement as delaying passenger trains; and on roads using block signals, neglect, inattention, etc., of operators.

The general means of following up train detentions has been through conductors' reports originally, by which means the operating officers are made aware of the causes for the detention. From that information the engineer's explanations are demanded. When it comes to equipment, the car inspectors and everybody concerned are asked to furnish information to work up the necessary data.

As to the methods adopted to remedy detentions from failures due to locomotive service, I should say that possibly the most important personage is the locomotive inspector in the roundhouse. Then, if the roundhouse organization is such as to be ample for the service required at that point, the work will be properly done, and thereby the inspector upheld in his work. After which will come the locomotive runner, who of necessity must do more or less inspecting.

When it comes to the train it would seem that an inspector who looks over the train on its arrival at its destination, is almost a necessity, for the reason that boxes which may be running warm can be then detected and marked, so that they may then be attended to before that car has a chance to get on the road again. Then there should be a regular inspection in the yard, with a

proper yard force, where any repairs, changes, etc., may be made. Air brakes and the steam heat equipment would also be tested and gone over thoroughly at this point.

Finally, there is, I believe, in practice all over the country the testing of air brakes in the train immediately prior to its departure. So that if the remedies outlined, under the head of remedies, which I have suggested, are followed, it would seem that we have taken almost as many precautions as we can to avoid delays.

Mr. Dale—I have been out of train service so long that it is almost impossible for me to say anything on train detentions from the standpoint of an operating officer.

One gratifying thing that Mr. Mendenhall reports there is that failures from equipment are about ten and a fraction per cent., and as I am in the supply business at the present time, it appears to me to be evidence of the fact that the railroads are gradually buying a better class of material. (Applause.)

Mr. Wattson, upon being called on for remarks, suggested that on the question of train detention, he thought that Mr. Wheatley could talk very intelligently, from the fact that he has occupied the position of train despatcher, both on Western and Eastern roads, and in that position he has had an opportunity to know more intimately concerning train detentions than almost any other officers on a railroad.

Mr. Wheatley—Mr. President, it is a very difficult matter to put your finger on one or two things that cause detentions to trains and say that they can be remedied on all roads. Each road has conditions peculiar to itself and to its own service. I am surprised to learn that 89 per cent. of the detentions to trains are due to the first three causes named by Mr. Mendenhall. I know that a very large proportion of train detentions are due to arbitrary causes, for which it would be very difficult to suggest a remedy. Detentions due to traffic are also difficult to control. Detentions due to operating, I think, are very largely matters of discipline, and as the discipline on a road is poor or good, its detentions are great or small.

A considerable portion of detentions to trains on single track roads are due to stopping for orders. Trains that have lost their rights must be obedient to orders from the train despatcher to proceed, and of course that takes considerable time, and unless the despatchers are particularly active and vigilant, the trains usually go to the stations before the orders are ready for them, and have to wait from one to five minutes. The remedy for that state of affairs is to so arrange your despatching force that the despatchers will not be crowded with work. I have known instances of detentions to trains that were very hard to explain—one in particular, that occurs to me just now, which happened a few years ago. Trains running east reported losing time on account of head winds, and to our surprise, within an hour the trains running in the opposite direction reported detentions from the same cause. (Laughter.) That is one of those things which it is very hard to find a remedy for, and there are many others of the same character.

Mr. Montgomery—I am very much gratified by the manner in which Mr. Mendenhall has analyzed this subject. When I see that only about 10 per cent. of the detentions are charged to the equipment, I think we are getting off pretty well. I notice 33 per cent. hot journals. I think some of these gentlemen who furnish the railroad companies with lubricants and bearings, and metal for making bearings and such things as that, might manage to reduce that somewhat.

Mr. Hustis—I judge that that chart was prepared by a gentleman interested in rolling stock and motive power. I noticed a detention the other morning coming down on the train from the upper part of Westchester county that is not covered in that chart, unless perhaps you would call it due to operating. On leaving the station a regular passenger of the train was delayed in reaching it, and the conductor knew him and held back the train for perhaps thirty seconds. We got to the next station, and another regular commuter drove down to the station with a rather slow horse and waved frantically for the train to stop, and expected it would wait for him, but it did not, and the gentleman

who sat with me said that the conductor would have used good judgment to stop and wait for the passenger. I said that I had seen such an occurrence at the last station, and that probably by the time we got to the junction, if the train was held up for every belated passenger, we would get behind the New Haven train, which was due there two minutes before our train was due, and further delay it about five or six minutes. Well, at the next station the same thing was repeated. A gentleman was coming down the hill, perhaps a quarter of a mile away, driving a faster horse, but he was unable to reach the train. What I wanted to bring out is that if you have accommodating conductors who will wait for belated passengers, you cannot depend on getting the trains over the road on time. There are many small items of this kind which can be looked after with resulting improvement to regular and prompt service.

Mr. Wheatley—I would like to ask Mr. Mendenhall whether his chart refers solely to passenger trains, or does it include freight trains?

Mr. Mendenhall—It refers solely to passenger trains. I will say as to the suggestion that the chart does not represent all causes of detention, that under the head of Miscellaneous will come everything which we are not able to classify, or rather which are not worth classifying under a separate head, there not being enough of them. For instance, under Locomotive Failures, I should say that failures which run up to one-tenth of 1 per cent. in a month should not be classified. It would not be worth while to take a record of that.

With regard to the conductor being slow, etc., I should say that would come under the head of Traffic. As I explained in my previous remarks, the unusual movement of passengers, their slowness in and out of trains, and the natural delays through just such occurrences as have been referred to, might be included under the head of Traffic.

While I am on my feet I might, for the interest of locomotive men, further analyze that matter of 33 per cent. of hot journals.

On locomotives that will be found to be divided into about 48 per cent. driving boxes, 30 per cent. crank pins, 8 per cent. engine truck boxes, and 15 per cent. tender truck boxes, and I will state as a very interesting fact that of the total number of hot driving boxes 50 per cent. occur on the right driving box, 25 per cent. of the remainder occur on the left driving box, leaving 25 per cent. of the whole number of hot driving boxes only occurring on the forward drivers. This refers now to engines with four drivers.

I would like to say that, so far as this chart is concerned, it is the result of a very wide observation, and covers a service throughout the country of about two million locomotive miles per month, and nine and one-third million passenger car miles per month. So you can see that the percentages are pretty well represented here.

Mr. Fowler—A number of years ago I had occasion to ride over a certain line three times a week, making a round trip for nearly a year. Two months of the time I was on the road every day. I was riding on all classes of passenger trains, local and through express. Along in March, when I began, it seemed to me that we were running behind a great deal, and I made such a remark to the superintendent of the road. He became very indignant at once, and said the trains were always on time. From the first of April to the first of the following January I kept track of every train I was on on that road. I was on the train at least three round trips a week—except when I was on the road every day, and I was on one train that was on time. I mean by "on time" that I gave them four minutes. The train that I called "on time" was a minute late. (Laughter.)

Mr. Meade—Mr. Mendenhall spoke in the first place of the percentage of trains that would generally be on time. He said that 34 per cent. would be late, that is, as much as a minute. I was looking over the percentage of the trains delayed on the New York Central during the month of November, which is not a very favorable month, and the percentage of passenger trains on time on the whole system was 92 per cent.—that is, local trains. Of the

through trains 82 per cent. made time. I think that is rather a favorable showing. A great many detentions of the through trains are not due at all to the road itself. They are often due to connections being late. Quite a large percentage could be attributed to that. I think every man in the transportation department or operating department who is here to-night was struck with the percentage of detentions which Mr. Mendenhall attributes to the operating of the road, that is, not to the equipment. Mr. Mendenhall's statement covers a very large system, of course, and it is very interesting to find out exactly what percentage is due to that; but I think it struck almost everyone that it is a very large percentage to attribute to the traffic of a road, and not to engine or car failures. I drew up a little schedule very much on the style of Mr. Mendenhall's. First of all—failures due to the engine. I am not in the motive power department.

First—Steam failures, such as arise from bad coal, and the weather, and inexperienced or bad firemen.

Second—Accidents from breakages, such as crank-pin or journals, slipped eccentrics, injectors, foaming, various matters of that kind.

The second division—failures due to equipment, say hot journals, air and steam apparatus and various matters of that kind.

Third—Atmospheric conditions, such as bad rail, head winds, snow and matters of that kind, which are practically arbitrary, according to Mr. Mendenhall's scheme.

Fourth—The operation; first, terminal work, switching, loading passengers, baggage express, mail, and delays by other trains, and all delays that are incident to a large terminal. Sixth, station and water stops, loading passengers and freight. Seventh, what might be classed as handicap, such as too fast schedule for train, extra stops added to its schedule, or overloaded trains, which is one of the most frequent causes of detention.

Eighth—Outside causes, arbitrary, such as drawbridges, detentions at connections and various matters of that kind.

The President—Are the delays on the road you speak of in the order named?

Mr. Meade—I cannot say that, because I have not any statistics to show it.

Mr. Molineux—I think I can explain Mr. Wheatley's statement about head winds. Winds from the side, especially with freight trains, which I think Mr. Wheatley refers to, are almost as bad as head winds; the roads running east and west do not always run due east and due west.

Some years ago, when a conductor on a passenger train, I had trouble at one station on account of unloading express matter. We got there about 4 o'clock in the morning. Naturally there was only one man to handle the express there. The delay occurred for some time, and finally I got orders that when I got through with my passengers, to start ahead and let the express go. We carried the express by one morning, but we never did after that, for the express company furnished enough men to handle the matter promptly.

Speaking of extra traffic with passengers at certain seasons of the year, I noticed some time ago at one station on the Pennsylvania road this notice: "Passengers will please enter the car from the rear platform." If that could be done more throughout the passenger service it would certainly shorten the stops at the station. If the passengers leaving the car go out through the front door, and those boarding the car enter through the rear door, you could carry on both operations at one time without crowding.

The President—Last night I boarded an Erie train at Middletown that was ten or fifteen minutes late, and a dozen passengers got on the car before any of the passengers who were in the car got off, and there was a jam in the vestibule which delayed the train two or three minutes. I believe if such an order as Mr. Molineaux spoke of was carried out there would be a great deal of time saved at stations.

Mr. Wattson—Mr. President, the greatest bugbear to a railroad superintendent and his superior officers in the operating department is train detentions, and I daresay that many superintendents in this country, if asked what percentage of the detentions were

due to engines and equipment, would say at least 80 per cent. (Laughter.) I have never known a superintendent who did not think that it was either the power or the car equipment that was at fault for most of his troubles. Like Mr. Wheatley, I am very much surprised at the classification of detentions which we have had presented before us to-night. It may be correct. I cannot dispute it, because I have never carefully classified train detentions, although I have prepared frequently general averages of detentions of trains on my division, for the purpose of comparison, to see how the detentions of one month compare with those of another month in the same year. I submit, however, that on a railroad which had no connections, or which did not wait for delayed connections, for instance, like the D., L & W., that if there was no motive power failures, there would be no difficulty in running 95 per cent. of the trains on time, because I feel that there are no other classes of detention but can be largely overcome by good discipline. But when it comes to dealing with engines and cars, which have so many different factors in the list of possible causes of detentions which discipline cannot control, the question as to remedy broadens very materially. Sometimes the trouble is due to faulty construction by the manufacturer—a poor machine always developing a weakness. Sometimes the purchasing agent buys poor fuel or too cheap supplies. Sometimes engines must necessarily be kept out of the shops too long, etc., etc. But leaving the engine and car failures out of consideration, the superintendent can control about everything else. In figuring the runs of his trains, he will make his schedules to provide for the maximum traffic which is to be handled on each of the respective runs, and he will discipline his conductors so that they will know better than to wait for a belated passenger coming down the hill.

As to delay caused by handling express, if you allow an express company to bring in all the business that can be gathered up at any town and load on one train, why of course that train will be late. But if you have the express company and the conductors

to understand that after the passengers are on the train and the baggage is off that the train starts, they will so distribute their business that there will be very little detention from this cause.

Mr. Wheatley—The statement of Mr. Mendenhall, which is now on the blackboard, it seems to me is of a great deal of interest as well of importance, and I would be very glad to see that printed in our proceedings, so that we may all have an opportunity to study it after we get home. I would like to ask one further question for information from Mr. Mendenhall. A very large proportion of the detentions to passenger trains are due to what might be called the overloading of the engines. Under what head are those detentions classified in the statement of Mr. Mendenhall?

Mr. Mendenhall—Operating.

Mr. Wattson—My object in speaking of the possibility of running a road not having any connections on time was for the purpose of referring to what might be termed progressive or accumulative delays—that is, after the first detention to the train the delays generally increase as it proceeds—if not directly to the particular train, to some other train affected by its movement. Delays on account of waiting for connections are the most troublesome, from the fact that the train despatcher cannot figure accurately what the detention will amount to—if he attempts to help other trains on the reported detention of the connection he will frequently find that the detention is greater or less than reported, and as a result things are mixed. If he waits till the connection arrives, he has so many orders to give at once that more delay follows in transmitting and getting them complete to trains. Also, when trains get behind time, a big effort is made by the engineer to recover, and these efforts often result in hot boxes, breakages of machinery or accident. Seldom does a train on time get into trouble. I think, therefore, the best way to run a railroad is to always keep on time. (Laughter.)

Mr. Donnelly—I want to say that the only interest that I have in railway equipment and supplies is in their use. I speak also

from observation and memory in regard to my own experience. We experience delays from most of the causes there mentioned. Some of them, however, cut very little figure—for instance, hot eccentrics; they are so few with us that it is hardly worth while to mention them. We have hot journals on our locomotives, and there is every effort made to prevent it, and yet it seems almost impossible—sometimes impossible to tell the cause. There probably is a cause, but it appears that it is almost impossible sometimes to tell just what it is. They do not cut a very large figure in detentions; hot journals on passenger coaches are a small percentage, and they are almost entirely caused by neglect on the part of the men who have them in charge. If they were looked after in time and adjusted, the thing would not have occurred in hardly any instance that I know of from having personally examined it. It was not due to the failure of material at all.

In regard to detentions in taking water, we do not call those detentions unless the standpipe is broken down.

Parting of trains—that hardly cuts a figure. Brakes, steam heat and parting of trains—none of those three cause us very much detention. Our chief detentions are from the operating. Our freight trains get in the way, and of those detentions I believe that 90 per cent. are on account of the failure of the men in charge of the trains. We have occasionally a little detention from a dilatory conductor. We stir him up and he gets along all right until the next time. We do not let the express goods detain a train more than once. The next time a train comes along to that station it won't be detained.

It is almost impossible to enumerate all the causes. I wish I had taken just a memorandum from the conductors' reports of all the different causes of detention for a month, and I think it would have filled a blackboard about three times the size of that, and it seems almost impossible to prevent it. We call the men up, we discipline them, and we find that it does not do very much good. Then we let them go without discipline, and it is about the same. If there is any gentleman here who can tell how that is

to be avoided, I will be glad to have him do so, but I myself have been unable to find out.

In regard to failures in machinery, they can be remedied. But unfortunately we do not make the men, and we cannot remedy any defects in them very much. You can only tell what a man is after you have tried him.

The President—My experience in respect to the delay of trains has been different on different roads. I think the failure of engines and cars is like an epidemic. We will have a run of hot boxes for two or three months and hardly any cause can be given for it. I think I can truthfully say that formerly we had fifty hot boxes on our road where we have one now. I think that has been brought about in one or two ways. We have changed the lubricants, and we have changed our construction, and I know we have reduced the number of hot boxes to that extent. There are failures of eccentrics, and the most of the items mentioned there by Mr. Mendenhall, and they frequently get, as I say, like an epidemic. There will be three or four or half a dozen eccentric straps, and then we will run eight or nine months and not have a hot box. It seems to me that the remedy for those things is a report from both departments. My experience on different roads has led me to believe that where the reports are all based on the conductors' reports, that there is but very little improvement. We have a system on our road by which the conductor reports to the superintendent, and the engineer makes a daily report to the superintendent of motive power, and we formerly found great discrepancy in the two reports, and the motive power failures would be sent to the superintendent of motive power by the division superintendent or by the general superintendent, and the failures of operating which were shown by the engineer's report, which the conductor frequently would ignore entirely, would be sent to the other department. A short time ago I rode on one of our trunk lines running into Buffalo, and over a division that had a good many freight trains. We were blockaded about twenty minutes with a slight freight wreck, and when I retired at night

we were about thirty minutes late. When we arrived at Buffalo the porter came through the car and called out "Buffalo," and I asked the conductor, who passed through, whom I had known for several years, how we were, and he said, "On time." I said, "How is that? When I went to bed you were forty minutes late, and you hardly ever make up anything on this division." He said, "Under the old superintendent we would not have done it; we would have come into Buffalo an hour and a quarter late. We have passed twenty freight trains since you went to bed. Formerly we would have lost that time; every freight train would have stolen from our time. When the new superintendent came in he called all passenger and freight conductors before him and he said: 'I notice that there is only one class of trains on this road, and that is second class. Now I am going to make it a penalty of one day suspension for every minute you delay a passenger train.' The freight conductors said, 'We will never get your freight trains over the road. Now, the freight men are swearing by this new superintendent. They are getting over the road, they say, better than ever before, and the passenger trains are all getting over the road on time."

As Mr. Donnelly said, I think a great many passenger trains, especially on single track, are delayed from freight trains pulling in two or three minutes ahead of the passenger train's time, and the passenger train is unable to make the time up.

Mr. Donnelly—I would like to add that our experience in regard to hot journals and failures of machinery is about the same as yours. It seems to run in epidemics, for a month or so; then then we will probably go for months with scarcely a failure. But I think, after all, when you come to take a year, and take the percentage of detentions from failures of machinery, that it is but a small proportion of the whole of the detentions coming under the head of what is there called "Operating and Traffic. I speak from an operating standpoint, and so long as our department cannot cut a better figure than that it is hardly worth while to find very much fault with the motive power department.

Mr. Wattson—I believe that on railroads having efficient officers and adequate power to handle their business, the principal cause of detention to trains, if carefully followed up, will be found to be due to atmospheric conditions; that extreme heat, extreme cold and severe storms have more effect on train service than any other single cause. It affects machinery, it affects material, it affects men, to such a degree that when there is a sudden change from one extreme to another, it is at once noticeable by train detentions.

Mr. Hill—While we are talking on train detentions, I will recall a little thing that came to my notice. I was once in our general manager's office and he called in an engineer for continued delays to his train, a through express. The first thing that the general manager said to him was, "John, you have been late eleven or twelve times this month; what is the matter?" "Well," he says, "I am popular. All these damn presidents and general managers from the East who want to go to California ride on my train. I always have a private car; on a long mountain grade that means something."

While on the subject of delays I want to call attention to the fact that on a great many railroads, perhaps the majority of statistics of delays are compiled from the conductor's report. In nine cases out of ten where the engineer's trip report has a detention blank on the back of it, nothing is ever done unless there is a case of suspension on hand. The suprintendent of motive power does not compile that table and figure on the thing as the superintendent does. What the officers of the road ought to get at is the truth, and then they can take these matters up one at a time and rectify them. On the government railroads of New South Wales they have a system that it seem to me would be very easily inaugurated here. They have special detention slips with blanks. It is a graphic thing; there is an outline of the road, a blank line for making the detention mark opposite every station or between every station. That is made out at the end of the trip by the engineer before his engine is detached from the train, and the con-

ductor has to go to that engine and sign that slip. There can be no lying between the two departments. They must settle right there before they end their trip what has delayed that train. Both men sign the same report and it goes to the general officer. Now, if they could do something like that, they would get at the actual truth. I know that the train delays in nine cases out of ten as reported on the D. & R. G., while I was there, were "No steam," "Engine slipped," "No sand." The conductor slept in the caboose half the time and did not know what was the matter—might be off the track.

Mr. Mendenhall—I do not know that I made myself clear in my original remarks. The statement which I made about the conductors' reports was that they were used as a record for the operating officers, and that record includes every detention to the train from the standpoint of the conductor. It is used only as a record. The records from which this table was compiled are absolute records, each case of which has been explained by the parties in question. Should a conductor report a detention, and there be any question between the engineer and conductor as to the reliability or authenticity of that report, the matter is not entered in the record which is kept until the responsibility is fixed; it must be on one or the other, or for some cause or for another cause; and when that is determined, it is finally entered in the record, and that is the record which is relied upon and kept. I do not see how anybody can talk from figures on train detentions unless each detention is sifted down to the final cause. It may not always be possible to give a cause, but the actual facts as they appear at the time of the train stopping, if it stops, or the delays, when they occur, will appear to some man on the train.

I would like to say to Mr. Donnelly that I think he misapprehends the item there "Taking water." That refers only to taking water from track tanks. Stopping to take water from a stand pipe would be an operating detention.

Mr. Woolson—I have been immensely interested in this discussion, but there is one little item which I have not heard mentioned

at all, and that is the want of harmony between train crews at the time of an accident. I call to mind an experience which I had on the Chicago & Atlantic road a few years ago, in which a freight train, which was proceeding at the head of our express, had broken an axle about fifteen miles this side of Mansfield, and the passengers stayed, I suppose, ten or fifteen minutes in the coaches before they got enthusiasm enough to go forward to see what the trouble was. That was in the night. At length several passengers went forward, and it was ascertained beyond any question that the two crews were not working in harmony, and it has been a sort of puzzle to me to what kind of a report the conductor of each train would make in a case of that kind. The want of harmony, in that particular case, I feel satisfied, made a difference of fifteen or twenty minutes in our train.

Mr. Donnelly—While we are discussing the subject, there is one feature of it that has not appeared here, and I would like to hear from some of the railroad men what their practice is in making out conductors' reports. That is to say, if a train arrives at the end of its trip on time, are all the detentions that occur during the trip, and that are made up, reported, or do they simply make out a report of detentions that prevent the train from ending its trip on time? Now, both practices have been in use; I have myself used both. At present we are reporting all detentions, no matter whether the train is late or whether it arrives at the end of its trip on time. But there was a time when there was a different practice. That makes some difference in charging up detentions at the end of the year.

Mr. Wattson—We get a detailed report from the conductor at the end of each run, both on freight and passenger trains, showing the detentions—all of them, and these detentions are included in what we call our 25 Report; that is, a train report made to the general superintendent at 7 o'clock in the morning and 3 o'clock in the afternoon, and a copy of that report is sent to the general manager and to the superintendent of motive power, and also to the master mechanic. Every one interested sees exactly all the

detentions that have occurred to a train *en route*, no matter whether it finishes on time or not.

Mr. Donnelly—Do you ever have occasion to correct conductors in their reports?

Mr. Wattson—Yes, quite frequently. The conductor may report that he lost time on account of the engine not steaming, or on account of the engineer not making time. The master mechanic then takes the matter up with the engineer and he makes a report —he may remember that at two or three stations the block signals were not given promptly, and he had to slow up; or that he had to make an extra stop to let off a passenger whom the conductor overlooked. And then the master mechanic comes back and says the conductor's report is wrong, and asks to correct it. We take the matter up again with the conductor, and finally get the exact facts. But whenever we find that a conductor has misrepresented the case, or that an engineer has made a misstatement, we take advantage of the opportunity for a lecture on the folly of lying, and give a little medicine for the cure of the disease.

Mr. Donnelly—I think I have seen conductors' reports where the detentions, when footed up, amount to more time than the train has been on the road from start to finish. (Laughter.)

Mr. Wattson—Do you pay your conductors for overtime, for detention?

Mr. Donnelly—Not on passenger trains.

Mr. Wattson—But on freight?

Mr. Donnelly—We do on freight, yes.

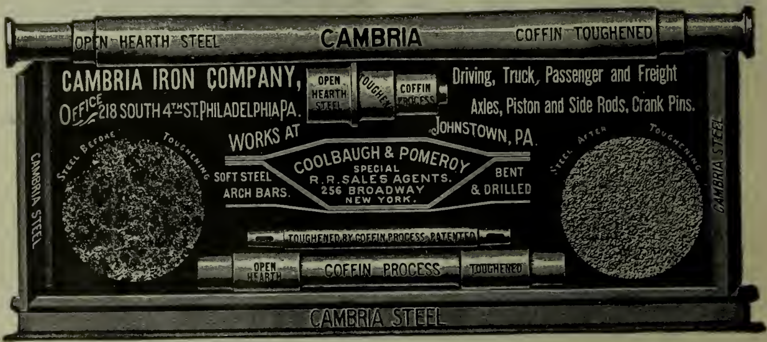
Mr. Wattson—That may account for some of these long detentions.

Mr. Donnelly—Well, I am afraid it does somewhat. I am afraid that is one of the evils which it is difficult to correct.

The Secretary read a list of thirty-one candidates for membership who had been approved by the Executive Committee.

On motion of Mr. Mendenhall, the Secretary was directed to cast a ballot for the gentlemen named.

The meeting adjourned at 10:40 P.M. Refreshments were served after the meeting.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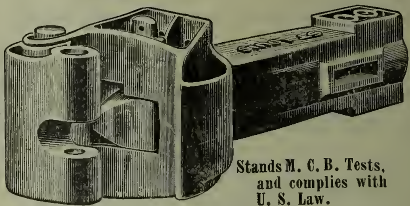
The St. Louis Coupler.



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ST. LOUIS, U. S. A.

The St. Louis Coupler.

Service Record.—Number of cars handled in interchange at St. Louis for year ending July 1st, 1894, equipped with St. Louis Couplers, 29,092 or 58,184 Couplers. (See Railway Review of Nov. 10th, 1894.) Percentage of Couplers broken, fifty-nine one-hundredths (.59) of one per cent. ST. LOUIS, U.S.A.

PROCEEDINGS

OF THE

New York Railroad Club.

Meeting held at the Rooms of the American Society of Mechanical Engineers, 12 West Thirty-first Street, New York, on Thursday Evening, January 16, 1896.

President West called the meeting to order at 8:15 P. M. On motion the calling of the roll was dispensed with.

The secretary read the minutes of the previous meeting, which, on motion, were approved.

The secretary read an invitation from the Society of Civil Engineers.

On motion of Mr. Mendenhall the secretary was directed to acknowledge the receipt of the invitation.

Vice-President Vreeland, at the request of President West, took the Chair, the latter wishing to engage in the discussion from the floor.

The CHAIRMAN—The Chair will call on Mr. West to present some suggestions with reference to the handling of the subject which is before us to-night—the Revision of the Rules of Interchange.

Mr. WEST—I would say that I was at the Buffalo meeting last week, and I thought the way the matter was handled there was very good. They covered the ground, and it was done very promptly. It was the result of three or four days' labor on the part of Mr. Waitt, of the Lake Shore & Michigan Southern. I invited him to be present here to-night, but I understand it is impossible for him to get down here. I have a copy of the recommendations adopted at the Buffalo Club, and with your permission, as the rules are discussed, I will read the recommendations of the Buffalo Club, and it will be for the club to decide whether they will pass upon the recommendations of the joint committee at Pittsburgh, or the recommendations of the Buffalo Railroad Club.

Mr. MENDENHALL—In order that the meeting may understand what was done with the Master Car Builders' rules before this committee, it might be well to say that those rules were taken and compiled under separate heads. There were not many changes made. The changes which were made were simply to incorporate the idea of the Chicago agreement, so called. In a general way the changes were the grouping under proper heads and the introduction of the Chicago agreement.

Mr. JOHN MACKENZIE—Mr. Chairman, I am not a member of the New York Railroad Club, but I would like permission to say a word or two before these rules are discussed in a general way. But I am ready to sit down and wait until all the members of the New York Club have got through.

The CHAIRMAN—Do you propose to speak on the Interchange Rules?

Mr. MACKENZIE—Yes, sir.

The CHAIRMAN—I understand that Mr. West's suggestion would be one that would facilitate the handling of this question. The question of revision of the Interchange Rules is a very large one, and to handle it as laid out, rule for rule, would take a much longer time than we have this evening to devote to it. Mr. West's suggestion was to handle it as the other club did—grouped in subjects, rather than each rule independent and separate.

Mr. WEST—I would move that Mr. Mackenzie, who is the vice-president of the Buffalo Railroad Club, be allowed to speak. He may have some suggestions that would further facilitate the matter.

The CHAIRMAN—The club would be very glad to hear from Mr. Mackenzie.

Mr. MACKENZIE—Mr. Chairman, and gentlemen, I do not wish to take up much of your time. The Arbitration Committee met this morning, and it was agreed between Mr. Rhodes, Mr. Marden and myself that we should be here to-night. It seems to me that the code of rules proposed by the Committee of Twenty-one goes as far as possible in the line of getting us further into a rut that we have been getting into for the last ten years in the interpretation of the rules, by conglomerating and mixing up a lot of rules that do not assist the object that we have before us—that is, the smooth and equitable interchange of cars. The time has gone past when we can get together and say that you may receive a car if you want to. But the time has come when we must say you shall receive a car, and every place where the word "may" is introduced in this code of rules, the word "shall" ought to be introduced. The time has come when the transportation department has seen, under the interchange adopted at Chicago, that there is such a thing as passing cars without objection. Cars can be moved and they can earn money, instead of waiting for somebody to make up his mind as to whether they shall put an I O U on the car or not; and it lies with us whether we shall change the rules, and make them so simple and so positive in their operation,

that the cars must move, rather than have them stand on the side tracks until a few men who are able to earn a dollar and a half a day shall wrangle and decide whether the car shall move or not. The transportation departments of this country have come to the conclusion that a smooth interchange can be introduced. The Chicago agreement has shown that it can be done. The mileage of the cars has been increased a very large percentage, and the time has come when we must either do something or they will take it out of our hands and let somebody else do it. The transportation departments are ready to-day to take hold and make an interchange that will move the cars of the country.

I notice, in Rule 2, it says: "Cars offered in interchange should be in safe and serviceable condition, the receiving road to be the judge." Now I would say that cars must be offered in a safe and serviceable condition to move upon the line to which the car is offered. There is no question in my mind that all this business here of going through the multiplication table, adding to and taking from, going from 1 to 34, and then going through the alphabet six or seven times from *a* to *z*, illustrating all these rules and the interpretation thereof— all this has gone by. We must stop it. What we want to say is that cars shall be offered in a serviceable condition, and they shall be accepted. Make the owners responsible for the defects that follow under fair usage. Under the Chicago agreement we undertake, with about thirteen different paragraphs, to cover the entire code of rules, and everything is working smoothly. I might say that I am a member of the Arbitration Committee, and have been for a number of years, and we wrangled to-day for five or six hours upon some questions the like of which we never yet have had, with all the radical change that was made by the Chicago interchange agreement—the like of which, I say, we never yet have had.

Mr. WEST—I would like to endorse what Mr. Mackenzie has said, and before proceeding to the discussion of the rules, probably it would be well for me to read some data that I have here, showing the benefit that the Ontario & Western have derived from the Chicago agreement, and from the agreement entered into between the New York Central and West Shore and several of the roads East. The Chicago agreement you are all probably familiar with, but we are working under an agreement with the New York Central and West Shore, as covering freight cars with owners' defects, interchangeable without cards. The agreement reads as follows:

Owners' defect agreement, amended; covering freight cars with owners' defects interchangeable without cards from the railroad companies named below.

"The undersigned agree to accept their own cars home from the railroad companies named below, with any old defects which do not render the cars unsafe to run, or unsafe to trainmen, without cards, provided the defects

do not appear to have been caused by derailment, wreck or unusual rough handling.

"Any company party to this interpretation of the M. C. B. rules compelled to issue defect cards to connecting lines not parties hereto, for cars belonging to the undersigned for any of the defects herein covered, shall not be billed for such defects covered by cards should cars be returned to owners without cards having been removed; but in case a third party deems it necessary to make repairs covered by such cards, car owners will accept bill covering the same.

"Care must also be taken when cards are so used to write on cards the word 'agreement,' and to see that the defects are actually held or that owners are responsible as shown."

At Weehawken, where we have a large interchange with the New York Central and West Shore system, in January, under the old rule, we used 253 defect cards; in February, 261; in March, 275; in April, 208; in May, 238; in June, 200; in July, 215; in August, 247; in September, 41. We entered in the new agreement in September. You see how it dropped down—in October, 3; in November, 1.

At Utica, in January, there were 17 defect cards; in February, 10; in March, 15; in April, 5; in May, 21; in June, 15; in July, 11; in August, 2; in September, 3; in October, 4; in November, 1. This shows the benefits to be derived from a more liberal interpretation of the M. C. B. rules.

For the three months previous to this arrangement we paid $26.34 on defect cards. On Rule 8 we paid $471.64, and under the new agreement $2.49. We are not very much affected by the new interchange, as most of the roads in the new interchange are Western roads. On the foreign cars there was $469.94 from defect cards. Nothing on Rule 8. Nothing on the new interchange. The total is $980.41.

In the three months following the new interchange we paid $8.19 on defect cards; $314.63 on Rule 8, and $16.45 on the new interchange; on foreign cars, $466.91; making a total of $806.16, against $980.41.

This is the amount of bills passed for the three months previous to the new interchange: Defect cards, June, $218.86; July, $126.96; August, $150.46; total, $496.28. On Rule 8, June, $152.99; July, $218.39; August, $100.26; total, $471.54. Under the new interchange, June, 36 cents; July, $2.13; August, nothing; making a total of $2.49 for the three months on the new interchange.

The amount of bills rendered under this same agreement for defect cards was, June, $75.14; July, $106.25; August, $49.88; total, $231.17. Rule 8, $197.54 for June; $150.17 for July; $101.25 for August; total, $448.96. In the new interchange, June, $20.62; July, $11.87; August, $12.30; making a total of $46.79 on the new interchange.

For the three months following, under the corresponding head, there was $475, against $496 on defect cards; $314, against $471, on Rule 8; and $16.45, against $2.49; a total of $806.18, on the three months following, against $970.41, on bills passed.

Of bills rendered, there was $200.33, against $231 on defect cards; $300.50, against $448.96, on Rule 8, and $23.95, against $44.79, on new interchange. This, I think, shows a positive advantage in working under a more liberal interpretation of the M. C. B. rules.

Mr. MENDENHALL—If I understood right, there was an intimation made that a scheme was outlined at the meeting of the Central Club which facilitated the discussion of this revision. I would ask Mr. West to to give us that scheme, so that we may proceed with the discussion.

Mr. WEST—It was moved there that some one read the rules as recommended by the Pittsburgh meeting, and that Mr. Waitt should read the rules as he proposed to have them changed, which was adopted, and later on, Mr. Waitt simply read off his recommendations, and they were passed, from section to section, of the rules; so that they rescinded the resolution that was passed that both should be read. It will be for this meeting to decide whether or not some one shall read the printed proceedings of the Pittsburgh meeting, and the recommendation of the Committee of Twenty-one,, and some one else all these recommendations.

Mr. MENDENHALL—Could you say, Mr. West, for the benefit of the meeting, in a general way, what changes were made.

Mr. WEST—They changed nearly all the numbers of the rules and sections, and grouped all defects for which owners were responsible under certain rules, and all the defects for which the delivering roads were responsible, under other rules; so that, when a car inspector took up his book of rules, he would not have to look all over to see whether there was a defect that he should card for, or a defect that the owners were responsible for. If you will read Rule 3, you will notice that there are two or three defects for which it says that owners are responsible, and then, in the next section, in the same rule, will say—for this defect the delivering road is responsible. There were not many changes made in the rule, but rather in the grouping; that is, in respect to locating the responsibility. There were very few changes made in the recommendations of the committee.

Mr. MENDENHALL—My understanding is that the grouping was changed from a grouping under defects to a grouping under responsibility.

Mr. WEST—That is the idea. If some one will read Rule 3; there is no change in the first general rule.

The secretary read Rule 1.

Mr. WEST—There is no change in that.

The secretary read Rule 2.

Mr. WEST—There was no question on that. As Mr. Mackenzie says, it is for this meeting to decide whether they want to make any change in that rule.

Mr. MACKENZIE—Do I understand there is no change recommended there?

Mr. WEST—There was a recommendation; but it was allowed to

remain as it is, as I understand it. I advocated that the receiving road should be the judge. I think that was changed, Mr. Mackenzie.

Mr. MACKENZIE—It seems to me questionable whether the delivering road or the receiving road should be the one to judge as to the efficiency of a car or the safety of a car to run. You all know, of course, that we are in the habit of putting in joint inspection throughout this country at a number of different stations. The joint inspector enters upon his duties with instructions from the master car builder. The rules for the government of the interchange at that point are entirely wiped out so far as the Master Car Builders' rules are concerned. I will venture to say that there are not two joint inspection points in this country today that operate under the same interpretation of the rules. Take it at any point and compare it with any other, and you will find that there is a variation from the rules, and they get as far away from them as possible. Why? Because we have so many of these rules to be interpreted, and they are so differently interpreted by everybody, that you cannot have any uniform rule. The only way, it seems to me, to make it uniform is to wipe out these interpretations and simply say that car owners shall be responsible for certain defects, with the following exceptions—you shall receive the car with certain exceptions. We all know it is coming to that. I would say, let us wipe out all these interpretations and illustrations. I am free to say that ten years ago that could not have been done, for the simple reason that we had yet to educate and bring up to our understanding, the different classes of inspectors that we had taking care of our cars. But I believe we now have men earning $1.75 who can interpret the rules under the Chicago agreement, and do it faithfully and honestly.

Mr. MENDENHALL—I must object to what Mr. Mackenzie says about the receiving road. There are roads in the country which have light equipment, and I am pretty safe to say that all of us would not—could not accept that equipment to run in our heavy service. It would mean a wreck if we did. I do not see that we can improve this very much, and I do not believe that it would be wise to say in these rules that we can force another road to take our cars.

Mr. WEST—I notice that Mr. Rhodes, a member of the Chicago agreement, has just come into the room, and I think he could enlighten us a little on this subject.

The CHAIRMAN—The club would be very much pleased to hear from Mr. Rhodes.

Mr. RHODES—Mr. Chairman, I have just come in, and I hardly know what is being discussed. If you will allow me to sit in the room a while, I shall be very pleased to say something a little later.

Mr. WEST—I would say for the information of Mr. Rhodes that we are just on the point of discussing the M. C. B. rules.

Mr. WATTSON—Mr. Chairman, I take it from Mr. Mackenzie's remarks that he has in view the facilitating of the movement of cars; while

Mr. Mendenhall has in view the idea of safety to the road receiving the cars. There are two sides to the question. Our line has just issued an order to all junction points, that no car of less than 30,000 pounds capacity will be received from any connection. We have found that small cars handled in trains of large cars—cars exceeding 50,000 pounds capacity—are liable to, and do very often, collapse and cause serious wrecks; and while it is very desirable to facilitate the movement of freight and to avoid delays at the junction points, I think that the highest and most important consideration is the one of safety, and on that point, I think, the receiving road should be the judge every time.

Mr. WEST—I would move that Rule 2, as read, be adopted as the sense of this meeting.

The motion was carried.

The CHAIRMAN—The Chair will have to ask for some indulgence in regard to this subject, as he has not been largely engaged in interchange the last two years, and as it is always well to have the man who knows the least about the subject for chairman, because he cannot say anything about it, I suppose you will not expect much.

The secretary read Rule 3.

Mr. WEST—Mr. Waitt's suggestion, which was adopted by the Buffalo Club, added a clause to that, reading as follows:

"Defect cards cannot be required for defects for which owners are responsible."

Mr. PHILLIPS—That provision is already made in the third line of Section 1, where it says: "That owners are not responsible for them." If owners are not responsible, it is clear that defect cards will not be demanded.

Mr. WEST—In case the Ontario & Western was delivering a car to a road that was not a party to the agreement, that they should demand a card for a defect for which the owners are responsible, that car might go on to some other road, and the company putting the card on would be billed for defects for which they were in no way responsible.

Mr. PHILLIPS—But these rules, which we are endeavoring to formulate to-night, are to be a code of rules governing the condition of and repairs to freight cars for the interchange of traffic, and are applicable to all the roads in the country, and not merely to roads of any particular section of the country.

Mr. MACKENZIE—It seems to me that this Committee of Twenty-one had this defect card plastered on them pretty well when they got together. The idea of a defect card, before we know what we are using it for, is entirely out of the question, it seems to me. It seems to me that we should say what the defects are, and then go on to deal with the defect cards. I think, in the fourth line, if we should simply say, the receiving road shall demand a defect card for any of the defects for which owners are not responsible, it would cover the whole thing. This defect card, it seems to me, should be put away back in the rules, where it belongs.

After all these defects have been enumerated, then bring in your defect card covering the defects.

Mr. PHILLIPS—The suggestion of Mr. Mackenzie would seem to be merely a matter of grouping the rules, which, as I understand from what Mr. West has said, will be taken up after we have discussed the merits of the rules themselves. Subsequently, I take it, we shall discuss the classification of the rules with regard to owners' responsibility, and the responsibility of the road handling the car, so that we might pass over the mere location of the defect cards at present, and discuss the merits of the rules. In this section 1, I think, something should be said about old defects. A great many defect cards are put on cars, I understand, for old defects, which should not be carded for. I think a paragraph should be added to that section that defect cards cannot be demanded for old defects.

Mr. WEST—That was the addition that the Buffalo Club added to this rule.

The CHAIMAN—Will you read that again, please, Mr. Wattson?

Mr. Wattson read the rule again.

Mr. WEST—Now, the Buffalo Club added: "Defect cards cannot be required for defects for which owners are responsible." Then Rule 4 gives defects for which owners are responsible, which, I think, is a decided improvement. I would move that this rule, with the addition recommended by the Buffalo Club, be adopted as the sense of this meeting.

The motion was carried.

The secretary read section 2 of Rule 3.

Mr. WEST—You will notice that that was left out in the rule as recommended. Now, if Mr. Wattson will read on, you will see how confusing those sections are.

The secretary read sections 4 to 39, inclusive, and the note.

Mr. PHILLIPS—I would like to point out, that by reference to section 17, referred to in the note, you will find that section 17 relates to wheels and axles, while under this heading it relates to brakes.

Mr. MENDENHALL—That is evidently a mistake. It should read 34, 35, 36 and 38, instead of the figures given.

Mr. WEST—You will notice, gentlemen, that in these rules there was a division of responsibility. It often puzzled inspectors as to which defects were chargeable to owners and which were not. The only object that Mr. Waitt had was to select those defects which were chargeable to owners and embody them all in one set of rules, giving them different numbers. Then farther on in the book, or in the numbering of the rules, are defects for which the owners were not responsible. So that when there was a defect discovered on a car, an inspector would look right to his book and see whether it was a defect for which his own road was responsible, or the delivering road. It seems to me that we are not going to expedite the matter if these rules are to be read over and re-read over. I have no idea

in the matter, any more than to give you the benefit of the Buffalo meeting.

Mr. MENDENHALL—I would like very much to hear the section of the rules as proposed by the Buffalo Club read. I have very serious doubts in my mind as to the advisability of placing in the rules items or sentences covering defects—placing in two different parts of the rules sentences covering similar defects. It occurs to me that the ordinary car inspector could take a set of rules, as these proposed by this committee, and could see his way through them a great deal better than if we put the same thing in two or three parts of the book. If it is a question of body he will look right under the defects of body, and he will find what he wants there. If there is any question of the responsibility it occurs to me that we should have it in these paragraphs here, but group them so that a man can put his hand on them. Before forming a definite opinion I should like to hear a section of these rules read.

Mr. WEST—What was formerly Rule 5 should now be Rule 4. The rule is headed, "Defects for which car owners are responsible." It starts with defects of wheels—"shelled out; wheels with defective treads on account of pieces shelling out, leaving flat spots deepest at the edge, with a raised center. Wheels must not be condemned from this case, unless the spots are over 2½ inches, or are so numerous as to endanger the safety of the wheel." Now, the words, "Repairs chargeable to owners," in the section Mr. Wattson read. they have erased, because the rule is headed, "Defects for which car owners are responsible."

"Sec. 2. Seams 1 inch long or over, at a distance of ½ inch or less from the throat of the flange, or seams 3 or more inches long on any other point of the tread.

"Sec. 3. Worn through chill; when the flat spot caused by wear exceeds 2½ inches in length. Care must be taken to distinguish this defect from flat spots caused by sliding.

"Sec. 4. Worn flange; flanges 1 inch thick or less, or having flat vertical surfaces extending more than 1 inch from tread.

"Sec. 5. Thick flange; flanges over 1 7-16 nches thick. This does not apply to wheels cast prior to September 1st, 1894.

"Sec. 6. Tread worn hollow; if the tread is worn sufficiently hollow to render the flange or rim liable to breakage.

"Sec. 7. Burst; if the wheel is cracked from the wheel fit outward, by pressure from the axle.

"Sec. 8. Broken or chipped flange; if the piece broken off exceeds 1½ inches in length and ½ inch in width, or if it extends ⅛ inch past center of flange, and if caused by seams worn through chill or worn flange.

"Sec. 9. Broken or chipped rim; if the tread, measured from the flange at a point ⅝ inch above tread, is less than 3¾ inches in width (see Fig. 5) and if caused by defective casting.

"Sec. 10. Cracked tread, cracked plate, one or more cracked brackets, or broken in pieces under fair usage.

"NOTE—The determination of flat spots, sharp flanges, thin flanges and chipped treads, shall be made by a gauge as shown, applied to M. C. B. standard wheel tread and flange in Fig. 1-a."

Then comes the wheel defect gauge and the maximum flange thickness gauge. Then defects of axles:

"Sec. 11. Axles bent or broken, or with collars broken or worn off, under fair usage.

"Sec. 12. Axles with dimensions less than the following prescribed limits.

"Sec. 13. Loose wheels.

"Sec. 14. Out of gauge, as indicated in Figs. 6 and 6a. For inspecting wheels, measurements to be made at the same height on the wheel as at the center of the axle."

Defects of trucks:

"Sec. 15. Defective, missing or worn out parts of trucks not elsewhere mentioned, which have failed under fair usage and are not due to derailment or wrecks.

"Sec. 15½. Trucks or parts of same of such inferior design as to be made unsafe.

"Sec. 16. Trucks having any parts less than 2½ inches above the top of the rail."

The CHAIRMAN—I think that covers what Mr. Mendenhall asks for. Mr. Mendenhall requested the reading of that in order to see how it compared with the pamphlet handed to the members. The Chair would suggest that the club arrive at some definite method of handling this question, as nearly an hour has been taken up now, and we have made no progress whatever.

Mr. MENDENHALL—I think that most progress can be made, as the President suggests, by determining on some outline to follow. If it is the sense of the meeting that it is better to make a grouping on the lines explained by Mr. West than to follow the lines suggested by the committee, why, we had better proceed with the data which Mr. West has and follow that. Otherwise, we better follow this.

Mr. PHILLIPS—There are two methods; one is to go through the matters as they stand in the report of the Committee of Twenty-one, and the other to accept the rearrangement proposed by the Central Railroad Club. We cannot do both at the same time. I think we had better go through the rules and discuss the merits of them first, and then we can discuss the arrangement of them subsequently, and their classification according to the Buffalo Club, if we deem that necessary. But I think we can best facilitate matters by discussing the rules individually, and I move that we do so.

The motion was seconded by Mr. Mendenhall and carried.

The CHAIRMAN—It still remains for the club to say how the subdivision of these rules shall be handled. I would like to ask if it is the

desire of the club that each section be read and passed upon as read, or all sections embraced under one rule.

Mr. PHILLIPS—The idea that I had was that the secretary proceed with the reading of the rules, and that unless any one rises to offer any suggestion or change to a section as read, that it be passed without going through the formality of taking vote on each section.

Mr. WEST—I would second that motion.

The motion was carried.

Mr. MENDENHALL—I understand that we have got through section 1 of Rule 3, and we have agreed to accept the recommendation of the Central Club for that paragraph.

The secretary read sections 2, 3, 4 and 5 of Rule 3.

Mr. SINCLAIR—Mr. President, the secretary has already read up to section 39. I think it would facilitate matters very much if we would allow him to proceed from 39, if any one wants to make an amendment of the previous sections let him propose it, without having to read all these long sections over again. I make that as a motion.

The motion was seconded by Mr. West and carried.

The secretary read sections 40, 41 and 42.

Mr. MENDENHALL—Section 42 is not clear. It may be clear to us, but I do not think it would be clear to car inspectors. I do not think 90 per cent. of the car inspectors of the country will understand section 42 on page 9.

Mr. WEST—Please read the two sections together—42 and 43.

The secretary read sections 42 and 43.

Mr. WEST—One section starts off by saying defects for which owners are not responsible, and the next gives defects for which owners are responsible.

Mr. MENDENHALL—If my memory serves me right, Mr. Waitt is responsible for this sentence, and while he understands it and we all understand it as it is here, I say it is not clear to the inspectors, and I think that the best way out of it is to eliminate it altogether. I do not really see the necessity for it. I move that we omit section 42. (Seconded.)

The secretary read sections 43, 44, 45, 46, 47, 48, 49 and 50.

Mr. MENDENHALL—I would like to ask the indulgence of the club to return to section 49. I would like to strike out the word "recently" in section 49.

The motion was seconded by Mr. Wattson and carried.

Mr. PHILLIPS—I would like to inquire of the representative who attended the Committee of Twenty-one if section 50 is intended to include labor.

Mr. MENDENHALL—I cannot say.

Mr. COOLBAUGH—Mr. Chairman, Mr. Rhodes ought to keep his promise to the club. There have been three important questions acted upon by us, all of which have been before him and the committee of which he is a member, and it seems to me that some light might be thrown on

these points by him. I wonder if he would not oblige us by answering some of these questions. For instance, the word "recently"—he evidently knows why that word was used, and may have a reason that we ought to consider. I only speak of that as being one of the three questions.

Mr. RHODES—I would say in answer to that, that the word "recently," as I understand, was inserted in the rules some years agc because a great many sills were improperly spliced and had been running for a number of years, and the association did not want to condemn those cars which had been running, but they did not want any more sills to be spliced in that way. Therefore, at the annual convention, the word "recently" was put in, to prevent any more splicing. But that has been so long ago now that I really do not think it cuts much figure—having it in or not having it in. Probably it is more in keeping with the actual work at the present time to omit it.

If I may say one word further in answer to Mr. Coolbaugh, I think that in reading over these rules there is one thing that we ought to bear in mind, as it is a little puzzling and a little confusing. I am not a member of the committee who have had this work before them, and I am not very familiar with what their motives have been, and I have endeavored more to gather information and to try to find out what the purpose is and what the outline is, rather than to give any information in connection with it. But as I recollect, some of the gentlemen who have been prominent in framing this change in the rules had in mind, among other things, that the old rules gave reasons to inspectors for which they could reject cars. Under the rules as revised, I understand they want to make the rejection of cars less prominent and the acceptance of cars more prominent. Therefore, they have worded all their sections not to reject cars, but to accept the cars, and that becomes a little confusing, and when you read over these sections it is quite puzzling at first to get this new idea that you are giving reasons for accepting cars and not for rejecting them. Respecting the clause that is a little puzzling there in section 42, I suppose really that the Committee of Twenty-one will object to having section 42 taken out, because I think that to understand section 42 you have got to read section 2. Now, if you read section 2, you will see that it says cars must be accepted unless some of the defects enumerated below exist or exceed the limits given. Now, read section 42 in conjunction with section 2, and you will see that cars must be accepted unless some of the defects enumerated exist. Cars must be accepted, therefore, under section 42 unless they have damage for which the owners are not responsible. That means that under these new rules the owners would be responsible for all defects generally, but when a car is in a wreck they will not be responsible for that; so that under section 42, as I understand the new rule, they consider that an important part—that the car must be accepted unless it has some damage for which the owner is not responsible. Now, I think that perhaps it would have been wiser if section 2 had been made the rule in place of that section, and then let all the balance be sections under that

rule. But as it is now, that is a section, and to understand the balance you have got to read section 2 over every time. Mr. Mendenhall, who was at that Pittsburgh meeting, can perhaps explain whether I have the right idea or not.

Mr. MENDENHALL—I think Mr. Rhodes has the right idea. But, as I said a few minutes ago, personally I think we can omit section 42 without doing a great deal of harm. And I am free to say that in talking with car inspectors and men who would naturally handle this business, I find that none of them understand section 42, and I therefore think that it ought to be stricken out, or the Committee of Twenty-one should be instructed to make it so clear that there can be no misunderstanding.

The secretary read sections 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64; and Rule 4, sections 1, 2, 3, 4 and 5.

Mr. SINCLAIR—I move that unless an amendment is offered to any of those sections that Rule 4 be accepted as recommended by the Committee of Revision. There seems to be scarcely any objection to the rules as revised and any one having an objection probably has the rule in his mind and can bring out the point at once. So I think it would facilitate the business to let the rules pass unless any one proposes a change to some of the sections. Mr. West is very well versed in that, and I think his view on that would be worthy of hearing.

Mr. WEST—The objection to that is that the grouping of the rules was different in this Buffalo arrangement, and it is difficult for me to follow both papers and detect the recommendations. There is one of them I have in mind, and that is where the word draw-bar was used, the committee of the Buffalo Club recommend that the word coupler be used. We used the Car Builders' dictionary terms instead of the old M. C. B. rule terms. In the old rules there is a section which reads: "If M. C. B. couplers, brake levers, top and bottom brake rods, air brake hose are lost or missing on a line, they shall be replaced at the expense of the road handling car when such loss occurs, so far as material is concerned, but the owner may be charged for the labor involved in replacing such material." The Buffalo Club recommend that the words, "except air-brake hose," be added to that, which I think is a very wise recommendation. It is known that trainmen frequently burst an air hose in a train on a car near the engine, and there may be a car fifteen cars back with a good air hose on, and they put that next to the engine. It is not fair to the company that it should be required to pay for the labor of putting a hose on that car.

Mr. PHILLIPS—I move that the secretary read section 18 of Rule 4, and Mr. West will then be in a position to propose an amendment to it.

The secretary read section 18 of Rule 4.

Mr. WEST—Mr. Rhodes, what is your opinion in regard to that rule?

Mr. RHODES—I think that is right.

Mr. WEST—Then I would move that we add to that rule the words, "except air-brake hose."

The motion was carried.

The CHAIRMAN—Has any member any further amendments to suggest to Rule 4?

Mr. RHODES—I would like to call the attention of the club to section 8. I believe it is going to be necessary eventually to pass some limit probably as to when it is proper to charge a car owner for raising a car. I believe there are cases that will come up when the raising is done in such a way that it is not proper to charge the owner with it, and I believe it would be very well while we are going over these rules to perhaps consider how section 8 might be changed, so that only a satisfactory raising of the car to the maximum height of 34½ inches can be charged. For instance, a car may come on your line and it may be loaded, and the car measure below 31½ inches; now the road doing the work, perhaps for acceptance and perhaps on account of the difficulties of doing it with a loaded car, will raise the car so that it is 32 inches high, and that may not be satisfactory to the owner, and when he gets the car back, through a change in wheels or a change in brasses, the car may be less than 31½ inches empty, and he has to go ahead and receive it again. I believe that the raising of cars ought only to be charged for when the work is done properly, and when the car is up to 34½ inches empty.

Mr. WEST—That is a very good suggestion. I know that the roads are doing that—they are simply raising the car so that it will pass inspection just by driving a shim in. I would move that a section be added that no charges be made for raising a car unless it be raised to 34½ inches.

Mr. PHILLIPS—There are a few words in the first section that seem entirely superfluous—"but no bill shall be rendered for repairs which have not been made." If any one could explain why those words are there it might justify their existence.

Mr. COOLBAUGH—I asked that question of Mr. Rhodes, and Mr. Rhodes stated that it had been the custom on some roads—he did not mention any names—to render a bill for work not performed. I suggested to him that it might be well to say there, "Thou shalt not steal."

Mr. PHILLIPS—If roads have any officials who are so dishonest I do not think the fact need be advertised in the Book of Rules.

Mr. RHODES—Perhaps it is hardly fair to think that railroads and their officials are dishonest. I can explain that in a way which you will see that people who do that do not believe that it is dishonest. A car comes back on their line with a bad order card on. Sometimes these bad order cards are ripped off by boys and others, and they are lost. The railroad will take these cards off and they believe that the repairs are necessary while the car is on their line, and it will get to their shops to be repaired. If it does not get to their shops to be repaired, they believe that the other receiving roads will not take the car from them without getting a card for it. That is the way they ease their conscience about it.

Mr. WEST—It is true that cards are stolen off of cars in yards, and it is a custom of a great many roads to remove the cards and send them to the office. We have prices here giving a stated sum, which is all we can

charge foreign roads for those defects. There is no doubt that a great many bills are rendered for the prices named in this book, before the repairs are completed. As Mr. Rhodes says, a car may be got out of the repair yard, and that rule, I think, was made to cover just such cases. It would prohibit roads from rendering a bill until the repairs were actually made. They send those cards to the office to protect the companies, and there have been cases where the cars have got out on the line and delivered to other roads and the repairs not made.

Mr. SINCLAIR—I do not think that any great mistake is made in touching the conscience of people who send bills by that rule. A superintendent of motive power was talking to me lately and telling me some anecdotes about the curious charges he got for repairs of cars. He said that there was a particular car to which one of his foremen drew his attention as having had bills come in for repairing a sill that was said to be cracked, and it was merely a dry crack that was in it. He put a tack at the end of this crack, and thought that he would see if any more charges came in for it. The car was away a year or eighteen months before it came back to the shops, and the crack had not extended beyond the tack, but five bills had come in for repairs of the same crack. (Laughter.)

The CHAIRMAN—The Chair does not understand that there was any motion made with reference to the amendment of the rule. Have any of the members anything further to say in that direction? If not, it will stand as read. Is there anything further to say with reference to the sections of Rule 4?

Mr. MENDENHALL—As I understand, all parts of these rules following this, from Rule 5 on, are simply the rearrangement of the Master Car Builders' Rules. I would move, in order to save time, that we accept them as printed.

The motion was seconded by Mr. West and carried.

The CHAIRMAN—This brings the discussion of this subject back to the former proposition made by Mr. West with reference to the rearrangement of these rules.

Mr. WEST—Mr. President, I withdraw that motion. I do not think it was seconded anyhow. The only material changes in the rules were those I raised objections to or recommended to be made. The balance was simply a rearrangement of the rules, so that all the defects for which the owners were responsible were first in the book, and the defects for which delivering roads were responsible were arranged in the following rules. The words of the sections were not changed to any extent. It would take longer to read this over than it has already taken to read the others.

The CHAIRMAN—If there is no further discussion offered on this question, and no further discussion upon technical subjects, we will proceed with the regular order of business. The Chair will have to ask for information on that point. The secretary asks what action will be taken on the rules as a whole.

Mr. WEST—I think we can safely say that we recommend the adop-

tion of the Pittsburgh Committee's recommendations. I would move that the recommendation of the Pittsburgh meeting be adopted as the sense of this meeting, with the few additions or changes we have made in the rules.

The motion was carried.

Mr. COOLBAUGH—Mr. Chairman, can I say just one word without taxing the patience of the meeting? It comes in here, I think, quite appropriately, in regard to a statement made by our President early in the discussion. He stated that in less than a year the number of defect cards issued at one point had dropped from 275 to 1. The one thought that impressed itself upon my mind at that time was this: Does that not signify either one or two things—that the inspection that was carried on at the beginning of the year was radically wrong, or that at the end of the year, beginning with the month of September, the question of inspection was practically eliminated at that point? Or in other words, how can you account for the fact that with the same number of cars, in all probability—although that is not stated—interchanged at that point, there was only one car in the entire month? That signifies a great deal to the railroads of this country. It signifies either that the original inspection was wrong or that the cars are being run in such a condition that they are endangering the property of the company and the lives of their patrons. I believe that the other extreme has been reached; that instead of having an excessively rigid inspection, there is none, and that there ought to be a happy medium struck. Certainly the difference between 275 cars and 1 signifies something very serious in one condition or the other. Perhaps I have not made myself clear, or perhaps I am entirely off on the subject. If so, I shall be very glad to be corrected.

Mr. WEST—I would say for the benefit of Mr. Coolbaugh that the total number interchanged in one month in 1895 was 15,295, against 11,199. Our secretary can say whether he has had any more trouble with our cars failing on his road. We have with us to-night the superintendent of the Division which controls these cars, and he can say whether we have had as good results or not.

Mr. WATTSON—There is no doubt that the number of wrecks to Ontario & Western trains through defective equipment have decreased within the last six months, I fail to remember a single instance of trouble of this kind during the past six months, but can recall a number during the previous six months caused by defective cars.

Mr. WEST—I would like to ask Mr. Wattson whether it was not necessary for the heads of departments of both roads to go down and straighten out the inspectors, whereas now we don't have any trouble whatever.

Mr. WATTSON—Yes; such was the case.

Mr. COOLBAUGH—I hope I will not be understood as reflecting in any sense on this particular instance. It is only illustrative of what is the general result all over the country, because I know very well that what is applicable at one point under the same set of rules is applicable all over. A conclusion is very difficult to arrive at.

Mr. WEST—There was very little difference in the amount of money that it cost to do the work. There was very little money saved, but despatch was given to the business, and the issuing of defect cards was done away with.

Mr. COOLBAUGH—And the repairs?

Mr. WEST—The repairs were actually made, but they were made by the owners. As Mr. Sinclair said a short time ago, many of those defects for which cards were given were defects that did not interfere in any way with the running of the car. I think every member here who has had anything to do with defect cards will say that 75 per cent. of our defect cards are from 12 to 18 months old when they come to the office. We had a case at Utica, just before these rules went into effect, where a car was destined to the Soo Line, and it was three days getting across the transfer track at Utica. The car was going from the Ontario & Western to the R., W. & O. At Utica it was necessary to pass over the New York Central property, and it was three days getting over that point, and finally the car went on.

Mr. RHODES—If I may be allowed, I will say a little now in connection with what I was asked to speak about when I first came into the room, and which will also have a bearing on the question that Mr. Coolbaugh has brought up. The inspection, as it has been built up by the M. C. B. rules, has become a very rigid one, and the extent to which it has delayed freight and the expense that it has caused the railroads, I do not believe we all fully appreciate. I would like to cite some two or three cases that my attention has been called to recently. We have been working for some little time on a motto, "Good enough," and have been paying a great deal of attention to these two words. We have found that there is a great deal of work done in railroad shops, both on locomotives and cars, which does not come under these two words—it is "Too good;" and when you are put down close to work, if you will figure on what is good enough, and do not do any more, you will find that you will save a great deal of money for your company. We had occasion not very long ago to send some trucks to a railroad company whose car bodies we had destroyed, and we took good care to go over the trucks carefully before shipping them. I examined them personally myself before they left our shops. I saw that new axles had been put under the trucks. I think there were four sets of trucks. I thought the trucks were all right and in good shape. When they got to the road owning the cars, to my surprise, it was reported that part of the axles were not fit to be used. I wrote to the superintendent of motive power and told him that we would accept whatever he decided about the axles; the only thing that we stipulated was that he should look at them personally. I said that I had taken the pains to examine them personally before they left our road, and if his road decided they were not proper axles to use, I would be satisfied, provided he saw them personally. It was two or three months after that that I got a reply. He not only took the pains to examine them himself, but he had several of his master mechanics examine them, and they pronounced that seven of the axles were

not fit ones to be put under the trucks. They made a bill against us for them and we paid the bill; but I asked to have the seven axles sent back to our works, and when we got them I examined them and I could not find anything sufficient to warrant condemning the axles, and I ordered them put into service on the C., B. & Q. road, on our regular equipment. With a great deal of work about railroad shops the question of good enough is a very important one. We were turning out some swing beam hangers from our shops recently, and we have been punching a 2-inch round hole out and punching them hot, which required, of course, taking the hangers to the fire and heating them. We thought we would try to save this heating and taking to the fire, because we had a punch that was big enough to punch this 2-inch hole cold. As soon as the hangers were distributed along the division of the road, some of the inspectors and the shopmen, master mechanics and master car builders, began complaining about the condition of the hangers. They said it was a very rough job, and not fit to have left the shop. I asked them to send the hangers back which they took exception to, and the hangers came back, and we put them in our pulling machine in the laboratory and pulled them apart. The hangers which had perfect holes, and which there was no criticism about, pulled and broke through the body of the hanger at about 95,000 pounds. The hangers which had defective holes broke through the holes at 65,000 pounds. The cars that these hangers went under were 40,000 pounds capacity cars. There were eight hangers to each car. The total weight of the car, including the trucks, was only about 25,000 pounds. Of the imperfect hangers, which our men were criticising and saying that the job was not fit to have left the shop, we did not find anything that stood less than 60,000 pounds. After these results had been given to the men that had condemned the hangers, they at once said, "We have nothing more to say; they are good enough." A great deal of similar work has been carried on at inspection points, and many and many a car railroads have been forced to repair when there was no necessity for it. I do not, of course, advocate taking chances or neglecting work that ought to be done. But I believe that it is very important for a man in charge of men to know what is safe and what is not safe, and if in his anxiety to get things remedied which are not safe, he remedies everything that has a defect, he will prove a very expensive man to his railroad. I think with this new interchange, and with the car owners made responsible for the failed parts of their cars, that we are going to get much better service and much better work out of our equipment, and with no increased danger.

Mr. WATTSON—Mr. Chairman, I think the suggestions embodied in Mr. Coolbaugh's remarks are to the effect that the passing, from a very rigid car inspection to what may be termed a loose one, is worthy of consideration, and I do not wish to be understood that the immunity from accident during the past six months, which has characterized the service of the Ontario & Western cars on our line, was entirely due to the change of the inspection rules; on the contrary, I think it was more due

to the disciplinary measures which were applied. As I said before, during the previous six months they had a good many mishaps, and those mishaps were the reason or cause of very sharp disciplinary action with the inspectors, and I think that had more to do with the good service thereafter than the change of rules or the change in method of inspection. However, the very foundation of good service is good and sensible rules, as it is easy to have such rules observed, whereas it is next to impossible to obtain satisfactory results from rules which are wrong in principle.

Mr. COOLBAUGH—Mr. Chairman, I move you, that inasmuch as one road has been mentioned here to-night in connection with this discussion, simply as illustration, that the name of that road be expunged from the proceedings. I would like to explain. It is unfair to the Ontario & Western Railroad or any other road to be used as an illustration in a discussion of this kind. That is why I think it ought to be expunged. I should not like it, if I were connected with a road, nor would any of you gentlemen. It is not fair to the road. Therefore I hope that my motion will be seconded.

Mr. WATTSON—There is no reflection in anything that has been said against the roads interested. It is simply that these cases have been brought up to illustrate a point of the discussion as facts carry more weight than theories.

Mr.COOLBAUGH—Yes, but you will notice that there was but one road mentioned to-night. If there were several it would have been quite different.

Mr. WEST—It seems to me there is more at stake in this arrangement. Any one who has visited a car yard will notice that every road has a hundred or more cars around awaiting repairs. Frequently half of that number will be cars sent to the shop under a defect card. Some of those cars will be out of service ten days before the shop forces are able to make the repairs, and probably when they get to them they will make the repairs in an hour. That car has lost ten days for an hour's work. It goes out on the road, and at the first interchange there will be another little corner knocked off an end-sill,and it will get a defect card, and go through the same rigmaroie. Under our present arrangements that car will run until it is unsafe; meanwhile it has saved four or five shoppings; while under the old methods it would have been out of service during that time. I think that is where the railroad companies are going to gain more than anywhere else.

Mr. WOOLSON—Mr. Chairman, I fail to appreciate one thing—that is, the possibility of removing a card from a car before repairs are actually made. It seems to me to be a very bad system, and one liable to lead to serious results.

Mr. WEST—It is an absolute fact that cars have been condemned at terminal points for cracked wheels that were considered by inspectors as absolutely dangerous, that have afterwards made 3,000 miles to my certain knowledge.

The secretary announced that the Executive Committee had approved the nomination of twenty-four new members, whose names he read.

On motion the secretary was authorized to cast a ballot for the persons named; which he did.

The secretary read a letter from J. S. Lang's Son & Co., inviting the members of the club to visit the Bicycle Exhibition, now being held in Madison Square Garden.

The President announced that at the meeting in February the discussion of the large car question would be taken up.

The meeting then adjourned.

NEW YORK RAILROAD CLUB.

CONSTITUTION.

ARTICLE I.

The name of this organization shall be "The New York Railroad Club."

ARTICLE II.

Objects.

The objects of this Club shall be the advancement and dissemination, by conference and discussion, of knowledge concerning the construction, operation and maintenance of railroads and railroad equipment, and the promotion of social relations among railroad men and others of kindred interests.

ARTICLE III.

Membership.

Any person employed in the construction, operation or maintenance of a railroad or of railroad equipment, and other persons recommended by the Executive Committee shall be eligible for membership.

ARTICLE IV.

Officers.

The officers of this Club shall consist of a President, a First, a Second and a Third Vice-President, a Secretary, a Treasurer and three Executive Members, who shall each serve a term of one year from the date of his election or appointment, or until his successor shall be elected or appointed, and shall perform the usual duties pertaining to his office. These officers shall constitute the Executive Committee.

ARTICLE V.

Duties of the Executive Committee.

The Executive Committee shall exercise a general supervision over the interests and affairs of the Club, prepare suitable quarters for meetings and make all necessary purchases, expenditures and contracts required to conduct the current business of the Club, but shall have no power to make the Club liable for any debt to an amount beyond that which, at the time of

contracting the same, shall be in the hands of the Treasurer, in cash, and not subject to prior liabilities. All expenditures for special purposes shall be made only by appropriations acted upon by the Club at a regular meeting.

ARTICLE VI.

Finance Committee.

There shall be a Finance Committee, consisting of three members, who shall be elected at each annual meeting, and serve for one year, or until their successors shall have been elected. The duties of this committee shall be to have a general supervision of the financial affairs of the Club, to audit the books and accounts of the Secretary and Treasurer and to approve all bills before payment.

ARTICLE VII.

Committee on Subjects.

There shall be a Committee on Subjects, which shall be appointed by the Executive Committee. The duties of this committee shall be to select subjects for discussion at the meetings of the Club, and to arrange for the presentation of suitable papers in connection with subjects for discussion.

ARTICLE VIII.

Election of Officers.

Section 1. The officers, except the Secretary, shall be elected, as hereinafter provided, at the regular annual meeting of the Club, and the election shall not be postponed, except by unanimous consent.

Sec. 2. Not less than thirty days prior to the annual meeting of the Club, the Executive Committee shall mail to each member of the Club in good standing, with a printed return envelope, a printed nominating ballot for President, First, Second and Third Vice-Presidents, Treasurer, three Executive Members and three members of the Finance Committee. Opposite or after each designated office shall be left a blank space, in which the member may indicate his choice for such office for the ensuing year. Such nominating ballot shall also provide for the name and address of the member, who shall return such ballot. Each member, upon receiving such nominating ballot, may indicate thereon his choice for each office named, and return the same to the Executive Committee.

Within the three days next preceding the date of the annual meeting, the Executive Commitee shall canvass all the nominating ballots returned to them up to that time, and shall select as nominees for each office the two candidates who shall have received the greatest number of nominating ballots for that office. In case that the second choice for any office, as indicated by the nominating ballots canvassed, shall fall equally upon two or more members, all such members shall, together with the first choice, be

nominees for such office. In canvassing the nominating ballots, no ballot shall be counted, unless it shall contain the name of the member submitting it, and each member shall be entitled to return only one such ballot. The names of the candidates for office so selected by the Executive Committee shall all be printed upon a single ballot, and the respective offices for which they are candidates shall be indicated.

Sec. 3. At the time of the annual election of officers, the ballots prepared by the Executive Committee shall be distributed among the members present, who shall indicate their choice of the candidates nominated for the various offices by scratching off the names of all other candidates for the same office. The candidates who shall receive the greatest number of such ballots shall be declared elected. No ballot for other candidates than those named on the official ballot shall be counted.

"Tellers for the election shall be appointed by the Chairman at the regular meeting next preceding the annual meeting, who shall be prepared to receive ballots at and after 8 o'clock of the night of the election, and the polls shall remain open from that hour until the regular order for election of officers shall have been reached."

Sec. 4. A Secretary shall be appointed by a majority vote of the Executive Committee at its first meeting after the annual election, or as soon thereafter as the votes of a majority of the members of the Executive Committee can be secured for a candidate. The term of office of the Secretary thus appointed shall terminate with the appointment of his successor. The Executive Committee shall have power, by a two-thirds vote of all its members, to remove the Secretary and appoint his successor at any time. The rate of compensation of the Secretary shall be fixed, for the time that he holds office, by the vote of a majority of the Executive Committee.

Sec. 5. The Treasurer shall be required to give bonds in an amount which a majority of the members of the Executive Committee shall demand, and they shall fix the rate of his compensation. No bill shall be paid by him for the Club until it has been certified by the Finance Committee.

Sec. 6. Any vacancy in office, which may occur after the annual election, shall be filled, for the remainder of the term, by a majority vote of the Executive Committee.

Sec. 7. Sections 2 and 3 of Article VIII shall be printed on the back of nominating ballots sent under its provision.

ARTICLE IX.

Election of Members.

To become a member, a candidate's name shall be proposed in writing to the Executive Committee by at least two members in good standing. The fitness of the candidate for membership shall be considered by the Executive Committee, and, if approved, may be so reported to the Club, not less than thirty days after the candidate's proposal. The name of the

candidate shall remain in nomination not less than twenty days after being favorably reported to the Club by the Executive Committee, and shall be voted upon by ballot, unless withdrawn at any regular meeting of the Club thereafter, and two-thirds of the ballots cast at such a meeting shall be required to elect the candidate.

ARTICLE X.

Amendments.

The Constitution may be amended at any regular meeting of the Club by a vote of two-thirds of the members present and voting, such amendment having been proposed in writing and read at the previous regular meeting.

BY-LAWS.

ARTICLE I.

Meetings.

Section 1. The regular meetings of this Club shall be held on the third Thursday of each month, except June, July and August, at 8 o'clock P. M.

Sec. 2. The annual meeting shall be held on the third Thursday in November at 8 o'clock P. M.

Sec. 3. The President may call special meetings at such other times as he may deem expedient, and shall do so upon the written request of at least five members.

ARTICLE II.

Quorum

At any regular or special meeting, twenty-five members shall constitute a quorum for the transaction of business.

ARTICLE III.

Dues.

Section 1. The annual dues of members shall be two dollars, and shall be payable at the first meeting next following after the annual meeting or within thirty days thereafter.

Sec. 2. At the annual meeting of the Club, the names of those members whose annual dues are still unpaid for the year then ending shall be dropped from the roll, previous notice of at least thirty days having been given such members by the Secretary. The proceedings of the Club shall not be mailed to persons whose names have been dropped from the membership roll of the Club, and such persons shall not be eligible for future membership until all back dues are paid.

ARTICLE IV.

Order of Business.

The order of business shall be as follows:

1. Roll call.
2. Reading of the minutes.
3. Reports of committees.
4. Unfinished business.
5. New business.
6. Discussion upon technical subjects.
7. Election of officers.
8. Election of new members.
9. Appointment of committees.
10. Announcements.
11. Adjournment.

ARTICLE V.

Publications.

Section 1. The proceedings, or such portion thereof as the Executive Committee shall decide, of the regular meetings of the Club shall be published (standard size, 6 x 9 inches), and mailed to the members of the Club and to the members of other similar clubs with which exchange is made.

Sec. 2. The published proceedings of the first meeting next following after the annual meeting of the Club shall contain the Constitution and By-Laws of the Club, together with a list of the officers and members of the Club.

ARTICLE VI.

Decorum.

Except as otherwise provided in these By-Laws, all questions of order in the conducting of meetings shall be decided in accordance with Roberts' Rules of Order.

ARTICLE VII.

Amendments.

These By-Laws, or any of them, may be suspended or amended at any regular meeting of the Club by a vote of two-thirds of the members present and voting.

LIST OF MEMBERS

OF THE

New York Railroad Club.

Corrected to Feb. 10, 1896.

If the post-office address opposite your name is incorrect, please notify the Secretary at once. This list includes only those whose dues are paid up to 1896. All in arrears have been suspended.

Abbott, Ira.................................150 Broadway, N. Y. City.
Adams, F. D...Allston, Mass.
Akers, George J...........................Astor House, N. Y. City.
Albee, E. E.................................160 Broadway, N. Y. City.
Albright, William B............Fulton and William streets, N. Y. City.
Aldcorn, Thomas..................917 Havemeyer Building, N. Y. Ctiy.
Alpaugh, J..Phillipsburg, N. J.
Andrews, George W..............................Philadelphia, Pa.
Applegate, E. W....................................Corning, N. Y.
Avery, H. W...Cleveland, O.
Axford, C. M.......................251 Sumer avenue, Newark, N. J.

Bailey, Charles D..........................120 Broadway, N. Y. City.
Bailey, J. H................................32 Park place, N. Y. City.
Baines, Hugh..............................23 Broad street, N. Y. City.
Baird, William T...........................15 Park row, N. Y. City.
Baker, C. W.............................Tribune Building, N. Y. City.
Baker, E. W......................29 Vernon street, Brookline, Mass.
Baker, George H........................140 Nassau street, N. Y. City.
Baker, J. W...Dover, N. J.
Baker, W. C............................143 Liberty street, N. Y. City.
Ball, Charles A..............................32 Park place, N. Y. City.
Bangs, E. D.......................1522 Cedar street, Milwaukee, Wis.
Barber, A. G......................164 Purchase street, Boston, Mass.
Barnard, F. E...................11 and 13 Oliver street, Boston, Mass.
Barnes, David L.........................The Monadnock, Chicago, Ill.
Barnett, Stephen D................258 Montclair avenue, Newark, N. J.
Barry, Robert...............................115 Broadway, N. Y. City.

Bates, Edward C........................93 Oliver street, Boston, Mass.
Beach, J. W................................1 Broadway, N. Y. City.
Beckley, A. J........................327 Colony street, Meriden, Conn.
Belcher, A. W......................................Rondout, N. Y.
Benners, E. H......................................Elizabeth, N. J.
Benson, A. E.......................................Rondout, N. Y.
Berdan, William....................................Paterson, N. J.
Berg, W. G........................261 West 52d street, N. Y. City.
Bickell, C. H.......................21 Cortlandt street, N. Y. City.
Bishop, George C..................................Jersey City, N. J.
Blackall, R. C.......................................Albany, N. Y.
Blanchard, W. A............409 Western Union Building, Chicago, Ill.
Bliss, Alfred C.........................64 Reade street, N. Y. City.
Bliss, C. G..................65th street and Third avenue, N. Y. City.
Blye, H. C............................143 Liberty street, N. Y. City.
Boag, C. H..................................256 Broadway, N. Y. City.
Bolen, Charles M.....................151 West 130th street, N. Y. City.
Bowers, R. J.........................722 Park avenue, Hoboken, N. J.
Bowen, E. J.....................................Hornellsville, N. Y.
Boyle, W. L.........................652 Union street, Brooklyn, N. Y.
Bradley, C. W.......................West 42d street ferry, N. Y. City.
Brady, D. M........American Surety Building, 100 Broadway, N. Y. City.
Brady, J. B......................Room 147, 115 Broadway, N. Y. City.
Brangs, P. H..Hoboken, N. J.
Brown, H. E......................................High Bridge, N. Y.
Brown, J. Alexander........................330 Pearl street, N. Y. City.
Brown, J. D.......................................Bridgeport, Conn.
Bruck, Henry T.....................................Mt. Savage, Md.
Bruen, Albert E................256 Cumberland street, Brooklyn, N. Y.
Bryan, W....................................120 Broadway, N. Y. City.
Bryant, W. E.........................177 Avery avenue, Detroit, Mich.
Buchanan, E. G.......................26 Cortlandt street, N. Y. City.
Burgert, G..Ramapo, N. Y.
Burns, W. B..Syracuse, N. Y.
Bushnell, E. L.......................................Easton, Pa.

Cade, John T.........................26 Cortlandt street, N. Y. City.
Campbell, J. D......................848 East 134th street, N. Y. City.
Carr, Albert....................74 Ashland avenue, East Orange, N. Y.
Carson, J. A...............................97 Bank street, N. Y. City.
Casey, F. A...Billerica, Mass.
Casey, W. F..Suffern, N. Y.
Cass, C. P...Monett, Mo.
Caswell, F. K........................238 Laurel street, Hartford, Conn.
Chamberlain, W. E..................Harlem River Station, N. Y. City.
Chamberlin, John T....................................Boston, Mass.

Chambers, A. D.	26 Exchange place, N. Y. City.
Chambers, F. F.	N. Y. City.
Chandler, J. F.	New Brunswick, N. J.
75 Chapin, C. T.	Rochester, N. Y.
Chater, John A.	132 Nassau street, N. Y. City.
Childs, H. A.	Jersey City, N. J.
Christiansen, Alfred	West Troy, N. Y.
Christie, C.	Foot West 42d street, N. Y. City.
Christie, W. W.	Paterson, N. J.
Clapp, M. N.	Communipaw, N. J.
Clark, Bernard	Susquehanna, Pa.
Clark, David	Hazleton, Pa.
Clarke, F. H.	47 Cedar street, N. Y. City.
Clark, H. A.	115 Fulton street, N. Y. City.
Clement, W. P.	147 Fulton street, N. Y. City.
Coit, A. H.	13 Astor place, N. Y. City.
Cole, F. J.	Paterson, N. J.
Coleman, C. P.	So. Bethlehem, Pa.
Collins, G. Fred	57 Broadway, N. Y. City.
Collis, Lloyd	Havemeyer Building, N. Y. City
Colvin, Fred. H.	413 Pearl street, N. Y. City
Colvin, H. F.	116 North 9th street, Philadelphia, Pa.
Conard, G. P.	340 Grand avenue, Brooklyn, N. Y.
Conklin, A. F.	15 Park row, N. Y. City.
Conklin, F.	Newark, N. J
Conklin, H.	73 Warren street, N. Y. City.
Conrad, H. V.	North Tarrytown, N. Y.
Cooke, C. D.	Paterson, N. J.
Coolbaugh, F. W.	256 Broadway, N. Y. City.
Corey, Thomas F.	315 Exchange Building, Boston, Mass.
Coster, Edward L.	6 West 47th street, N. Y. City.
Courtney, W. J.	Cleveland, O.
Coutan, C. A.	29 Gold street, N. Y. City.
Covert, John A.	Jersey City, N. J.
Cravo, Francisco S.	Rio de Janeiro, Brazil.
Creamer, W. G.	96 John street, N. Y. City.
Crisson, George A.	115 Broadway, N. Y. City.
Cromwell, O. C.	Baltimore, Md.
Cromwell, Jacob E.	Stevens Institute, Hoboken, N. J
Cronise, E. S.	37 Broad street, N. Y. City.
Cummin, J. H.	Long Island City, N. Y.
Currie, J. C.	Jersey City, N. J.

Dale, C. H.	15 Warren street, N. Y. City.
Dampman, Samuel	98th street and Third avenue, N. Y. City.
Darwin, H. G.	160 Broadway, N. Y. City.

Davidson, R. J....................................Hillburn, N. Y.
Davis, E. E....................................Scranton, Pa.
Day, Clarence P....................................256 Broadway, N. Y. City.
Dayton, George E....................................42 University place, N. Y. City.
Dean, Nat. C....................................Geneseo, N. Y.
De Armond, W. C....................................49 Wall street, N. Y. City.
De Garmo, T. F....................................1014 Havemeyer Building, N. Y. City.
De Hart, W. S....................................18 Broadway, N. Y. City.
Demarest, C. T....................................Jersey City. N. J.
Demarest, George W....................................Baltimore, Md.
Derr, W. L....................................Port Jervis, N. Y.
Des Anges, Henry L....................................Hoboken, N. J.
DeWitt, E. F....................................Lansingburgh, N. Y.
Dice, A. T....................................Atlantic City, N. J.
Dickerman, Charles H....................................Milton, Pa.
Dickson, F. G....................................115 Broadway, N. Y. City.
Diem, William P....................................21 Cortlandt street, N. Y. City.
Dixon, J. A....................................160 Broadway, N. Y. City.
Dixon, R. M....................................160 Broadway, N. Y. City.
Dixon, W. F....................................P. O. Box 695, Paterson, N. J.
Donnell, A. L....................................Rutherford, N. J.
Donnelly, James....................................Easton, Pa.
Dowdell, A....................................120 Broadway, N. Y. City.
Dowe, G. W....................................Port Jervis, N. Y.
Draper, C. A....................................56 Beaver street, N. Y. City.
Dunbar, A. L....................................Meadville, Pa.
Dunn, Seeley....................................Russellville, Ky.
Dunne, Daniel....................................323 Pearl street, N. Y. City.
Durfee, William B., Jr....................................Box 362, Warren, R. I.

Ecclesine, J. B., Jr....................................1014 Lexington avenue, N. Y. City.
Ellicott, Joseph R....................................32 Park place, N. Y. City.
Elwell, C. C....................................Norwich, Conn.
Ely, F. G....................................29 Broadway, N. Y. City.
Ennis, W. C....................................North Paterson, N. J.
Errickson, John A....................................Jersey City, N. J.
Evans, G. F....................................160 Broadway, N. Y. City.
Evison, Samuel....................................331 Madison avenue, N. Y. City.
Ewings, C. H....................................Grand Central Station, N. Y. City.
Eyman, D. W....................................Cumberland, Md.

Farley, Howard N....................................Warwick, Orange Co., N. Y.
Ferguson, H. A....................................Jersey City, N. J.
Fischer, E. G....................................Adrian, Mich.
Fitchie, William....................................Middletown, N. Y.
Fitzhugh, A. A....................................Box 839, N. Y. City.

Flagg, George.............19th street and Penn avenue, Philadelphia, Pa.
Flint, George F..........................143 Liberty street, N. Y. City.
Focht, L.....................................South Bethlehem, Pa.
Ford, Lewis T...Trenton, N. J.
Ford, O. R.....................High and Pearl streets, Boston, Mass.
Ford, Porter D..............................Long Island City, L. I.
Ford, W. C..............................29 Broadway, N. Y. City.
Forney, M. N...........................501 Fifth avenue, N. Y. City.
Fowler, George L..........................53 Broadway, N. Y. City.
Fox, Sampson......................................Leeds, England.
Foxwell, Capt. C..........................50 Broadway, N. Y. City.
Francisco, Charles L.............................High Bridge, N. Y.
Frech, George H....................................Jersey City, N. J.
French, A...Pittsburgh, Pa.
Fuller, C. E..St. Albans, Vt.

Gaines, Fred. F.................................South Easton, Pa.
Gannon, F. S.......................Foot Whitehall street, N. Y. City.
Gardner, George A.......................64 Reade street, N. Y. City.
Gayley, O. C..............................160 Broadway, N. Y. City.
Gearhart, J. H.....................................Yellow Pine, La.
Gibbons, J. C.....................................Jersey City, N. J.
Gilbert, E. M.........................3 Dewitt avenue, Ithaca, N. Y.
Gilbert, J. C.......................180 Lefferts place, Brooklyn, N. Y.
Gilleland, D. J.......................132 Chestnut street, Newark, N. J.
Gillon, George L.......................204 East 43d street, N. Y. City.
Gilpin, F. M.....................318 Bullock Building, Philadelphia, Pa.
Gilpin, H. E...................................Hornellsville, N. Y.
Gleason, Lewis..................................Rio de Janeiro, Brazil.
Gold, Ed. E...........................6 Bridge Stores, N. Y. City.
Goodell, George H...............................Susquehanna, Pa.
Goodheim, Charles...........Mercantile Exchange Building, N. Y. City.
Gordon, H. D...........................71 John street, N. Y. City.
Gordy, James A.....................Franklin Street Ferry, N. Y. City.
Gorton, W. E.......................................Corning, N. Y.
Gould, C. A..............................120 Broadway, N. Y. City.
Gould, F. A..............................96 Pine street, N. Y. City.
Granger, J. A.....................West and Bank streets, N. Y. City.
Gray, Gen. J. B.......................Havemeyer Building, N. Y. City.
Green, Ashbel, Jr..................................Weehawken, N. J.
Grieves, E. W.......................................Baltimore, Md.
Griffin, P. H...Buffalo, N. Y.
Griffith, F. J.......................................Hoboken, N. J.
Gurney, W. H...........................94 Liberty street, N. Y. City.

Haff, Frank E..............................Long Island City, N. Y.

Haggerty, J. Henry........................30 South street, N. Y. City.
Hale, Henry S..................................Philadelphia, Pa.
Hamilton, Francis J....................74 Cortlandt street, N. Y. City.
Hamilton, Lewis M..............................Cumberland, Md.
Hammett, H. G....................................Troy, N. Y.
Handy, A. W..........................Box 1770, Boston, Mass.
Hannah, G. E.....................................Paterson, N. J.
Hannen, J.....................................Port Jervis, N. Y.
Hansel, Charles...................................Easton, Pa.
Harris, H. Wells..............................Susquehanna, Pa.
Harrison, W. H..................182 Carteret avenue, Jersey City, N. J.
Hartness, James...............................Springfield, Vt.
Hastings, C. L......................143 Liberty street, N. Y. City.
Haupt, S. B.....................................Watsontown, Pa.
Haven, G. G., Jr.....................17 East 44th street, N. Y. City.
Hayward, C. H.......................201 River street, Hoboken, N. J.
Hayward, H. S.................................Jersey City, N. J.
Hazlett, Robert.............................150 Broadway, N. Y. City.
Headden, George..............................Jersey City, N. J.
Hedley, E. M..................................Elizabethport, N. J.
Henry, Charles S...........................115 Broadway, N. Y. City.
Hertzler, J. P.................................Jersey City, N. J.
Higbee, F. E..................................Jersey City, N. J.
Higbid, F. S..................................Jersey City, N. J.
Higgins, Samuel.........................South Bethlehem, Pa.
Hill, Ebenezer.........................South Norwalk, Conn.
Hill, Edward.................................Philadelphia, Pa.
Hill, George A.....................Broadway Central Hotel, N. Y. City.
Hill, J. A.....................................256 Broadway, N. Y. City.
Hill, Thomas R...............435 North Broad street, Philadelphia, Pa.
Hillman, William........................64 Reade street, N. Y. City.
Hirt, L. J.....................................621 Broadway, N. Y. City.
Hoag, W. M....................................Weehawken, N. J.
Hobart, N. P...................................18 Broadway, N. Y. City.
Hoffecker, W. L..............................Elizabethport, N. J.
Hoffman, B....................147 West 64th street, N. Y. City.
Hogan, Sylvester..........................1479 Broadway, N. Y. City.
Holsman, G.....................................Jersey City, N. J.
Hopkins, C. H..................................Middletown, N. Y.
Hopkins, Charles F...................335 Sixth avenue, N. Y. City.
Howard, James......................23 West 84th street, N. Y. City.
Howard, John..................................New Durham, N. J.
Howe, H. B...........................Eveleigh, Sydney, N. S. W.
Hoyt, John S........................26 Cortlandt street, N. Y. City.
Huck, W. H.....................................Rutherford, N. J.
Hughes, C. C.......................Murray Hill Hotel, N. Y. City.

Hughes, R. S. . . . . 44 Exchange place, N. Y. City.
Hungerford, C. E. . . . . Jersey City, N. J.
Huntley, F. P. . . . . 120 Broadway, N. Y. City.
Hustis, James H. . . . . Grand Central Station, N. Y. City.

Jagoe, H. B. . . . . 363 Broadway, N. Y. City.
James, H. . . . . 60 Pearl street, N. Y. City.
James, James D. . . . . Doylestown, Pa.
Jerome, Lovell H. . . . . 138 Front street, N. Y. City.
Johnson, J. W. . . . . Jersey City, N. J.
Johnson, Wallace W. . . . . Ambler, Pa.
Johnston, H. C. . . . . Philadelphia, Pa.
Jones, B. M. . . . . 11 and 13 Oliver street, Boston, Mass.
Jones, Fred. W. . . . . 92 Garden street, Hoboken, N. J.
Jones, Horace . . . . 39 Cortlandt street, N. Y. City.
Joughins, G. R. . . . . Berkley, Va.

Kaczander, L. . . . . 416 East 106th street, N. Y. City.
Kearney, Alex . . . . Jersey City, N. J.
Keeler, H. E. . . . . 115 Broadway, N. Y. City.
Kennedy, George E. . . . . Sao Joao del Rio Minas, Brazil, S. A.
Kent, F. S. . . . . Jersey City, N. J.
Kerr, B. B. . . . . Pittsburgh, Pa.
Kinch, W. M. . . . . Mott Haven, N. Y.
Kinney, J. A. . . . . 305 Tenth street, Jersey City, N. J.
Kissam, G. F. . . . . Newark, N. J.
Kittell, C. W. . . . . Phillipsburgh, N. J.
Knapp, Lester I. . . . . 58 East Franklin street, Huntington, Ind.
Kuhn, H. J. . . . . 1711 North 15th street, Philadelphia, Pa.
Kuhne, Frederick J. . . . . Front street, N. Y. City.

La Bonta, W. F. . . . . Richmond, Va.
Lane, A. M. . . . . Schenectady, N. Y.
Larke, Richard A. . . . . Brooklyn, N. Y.
Lawless, E. J. . . . . 109 Liberty street, N. Y. City.
Leach, C. E. . . . . 66 Broadway, N. Y. City.
Leach, Henry L. . . . . 176 Huron street, North Cambridge, Mass.
Lentz, John S. . . . . Packerton, Pa.
Lewis, E. . . . . 129th street and Second avenue, N. Y. City.
Lewis, E. N. . . . . The Rookery, Chicago, Ill.
Lewis, W. H. . . . . Hoboken, N. J.
Libby, Robert E. . . . . Atlanta, Ga.
Lichtenhein, A. . . . . 249 Front street, N. Y. City.
Liscomb, O. P. . . . . 13 Hudson avenue, Albany, N. Y.
Little, Stephen . . . . Box 1300, N. Y. City.
Loftus, John J. . . . . 65th street and North River, N. Y. City.

Longbottom, George H..............................Paterson, N. J.
Loomis, E. E..............................Elmira, N. Y.
Loomis, W. H..............................168 Prospect place, Brooklyn, N. Y.
Lovejoy, Henry..............................Passaic, N. J.
Lowerre, George H..............................32 Park place, N. Y. City.
Ludlom, W. E..............................Pompton, N. J.
Lyons, N. B..............................39 Cortlandt street, N. Y. City.

Macdonald, J. V..............................323 West 89th street, N. Y. City.
Maguire, J. F..............................Elmira, N. Y.
Maguire, M. W..............................Jersey City, N. J.
Mahl, F. W..............................Sacramento, Cal.
Major, A..............................461 Pearl street, N. Y. City.
Mallinson, E. P..............................Brooklyn, N. Y.
Marley, George H..............................Grand Central Station, N. Y. City.
Martin, Charles W..............................71 John street, N. Y. City.
Martin, R. W..............................32 Park place, N. Y. City.
McCaleb, W. B..............................Bedford, Pa.
McCausland, A. C..............................Wilmington, Del.
McCoy, D. B..............................Grand Central Station, N. Y. City.
McGrane, John J..............................187 Broadway, N. Y. City.
McKeen, T. L..............................80 Broadway, N. Y. City.
McKelvey, C. D..............................Jersey City, N. J.
McKenna, R. F..............................Scranton, Pa.
McKibben, C. H..............................120 Broadway, N. Y. City.
McMunn, S. W..............................1425 Old Colony Building, Chicago, Ill.
McQueen, William J..............................317 East 149th street, N. Y. City.
Meade, R. W., Jr..............................Grand Central Depot, N. Y. City.
Meeker, George..............................Hoboken, N. J.
Mendenhall, C. M..............................Broad Street Station, Philadelphia, Pa.
Meneely, Charles D..............................West Troy, N. Y.
Meneely, George R..............................West Troy, N. Y.
Mercur, R. J..............................Buffalo, N. Y.
Messenger, J. H..............................Middletown, N. Y.
Millar, J. Graham..............................28 Ferry street, N. Y. City.
Millen, Thomas...Cable Building, Broadway and Houston st., N. Y. City.
Miller, C. C..............................16 Warren street, N. Y. City.
Miller, Fred. S..............................87 Maiden lane, N. Y. City.
Miller, George E..............................257 Broadway, N. Y. City.
Miller, G. W..............................Elmira, N. Y.
Milliken, James..............................Broad Street Station, Philadelphia, Pa.
Mills, Stott..............................Warwick, N. Y.
Minshull, P. H..............................Middletown, N. Y.
Minzesheimer, C. M..............................Edgewater, N. J.
Missimer, H. M..............................483 14th street, Brooklyn, N. Y.
Mitchell, A. E..............................21 Cortlandt street, N. Y. City.

Mitchell, Joseph........................556 West 27th street, N. Y. City.
Molleson, George E.....................39 Cortlandt street, N. Y. City.
Mollneux, L. E..............................Box 236, Metuchen, N. J.
Montgomery, H. S....................................Packerton, Pa.
Montgomery, W...................................Manchester, N. J.
Moore, J. F.....................................Middletown, N. Y.
Morris, W. S..Richmond, Va.
Morrison, J. C..........................Erie Station, Jersey City, N. J.
Morrison, George..............98th street and Third avenue, N. Y. City.
Morse, George C..........................586 First avenue, N. Y. City.
Mosher, F. R....................................Hornellsville, N. Y.
Moss, Lincoln......................71 Broadway, Room 10, N. Y. City.
Motley, Thornton N..........................43 John street, N. Y. City.
Muir, John...............14 Reservoir avenue, Jersey City Heights, N. J.
Munford, I. H..................................18 Broadway, N. Y. City.
Munroe, William C........................87 Maiden lane, N. Y. City.
Murphy, John...Paterson, N. J.

Naismith, P. L...Nova Scotia.
Nathan, Max.................................92 Liberty street, N. Y. City.
Nellis, F. M......................1207 Havemeyer Building, N. Y. City.
Newton, J. D...............................151 Maiden lane, N. Y. City.
Noyes, C. T.......................................Sacramento, Cal.

Olhausen, Joseph....................................Jersey City, N. J.
Onslow, Adolph........................Jersey avenue, Jersey City, N. J.
Otis, W. D...New York City.

Page, W. B..Albany, N. Y.
Page, W. Byrd....................................Williamsport, Pa.
Paine, Martin S...............................115 Broadway, N. Y. City.
Paist, B. F...........................Rio de Janeiro, Brazil, S. A.
Parke, R. A........................1207 Havemeyer Building, N. Y. City.
Patriarche, P. H............................480 Pearl street, N. Y. City.
Patrick, F. M.................................87 Maiden lane, N. Y. City.
Peabody, J. C...............................151 Maiden lane, N. Y. City.
Peckham, William M.....................................Troy, N. Y.
Peters, H. S..Dover, N. J.
Phillips, Edward A.......................132 Nassau street, N. Y. City.
Pierson, T. S................................621 Broadway, N. Y. City.
Pomeroy, L. R..................................33 Wall street, N. Y. City.
Pope, Ralph W......................1009 Havemeyer Building, N. Y. City.
Post, C. J...7 Dey street, N. Y. City.
Post, George A........................Havemeyer Building, N. Y. City.
Pratt, J. B..................................4 Fletcher street, N. Y. City.
Price, Lewis E.......................................Jersey City, N. J.

Priest, A. W.... ....East Albany, N. Y.
Prindell, T. H...Jersey City, N. J.
Prosser, C. S..............................16 Warren street, N. Y. City.
Prosser, Thomas.............................15 Gold street, N. Y. City.
Prout, H. G...................................32 Park place, N. Y. City.
Pudam, Thomas A.....................................Sacramento, Cal.
Purves, T. B., Jr.......................................Boston, Mass.
Pye, D. W.....................................160 Broadway, N. Y. City.

Quigg, H. J..........................New Brighton, Staten Island, N. Y.
Quincy, C. F...................................29 Broadway, N. Y. City.

Randolph, L. S......................................Blacksburg, Va.
Rauch, E. J...N. Y. City.
Rauch, Sydenham W..................682 East 139th street, N. Y. City.
Rauch, Warren A.......................301 West 116th street, N. Y. City.
Raynal, Alfred H....................11 Creighton street, Providence, R. I.
Reading, R. B.................................145th street, N. Y. City.
Reed, W. Boardman..........................621 Broadway, N. Y. City.
Reid, John I..Paterson, N. J.
Reid, John S..........................Cornell University, Ithaca, N. Y.
Reid, William L.......................................Paterson, N. J.
Renshaw, A. H...Troy, N. Y.
Reynolds, A. C.....................................Middletown, N. Y.
Reynolds, John M.............................756 Rookery, Chicago, Ill.
Rhea, Frank.......................Broad Street Station, Philadelphia, Pa.
Robertson, John H........................1119 Third avenue, N. Y. City.
Roe, W. Stuart.....................705 Havemeyer Building, N. Y. City.
Rogers, Frederick C...........................19 John street, N. Y. City.
Rolfe, H...Hartford, Conn.
Ross, William...Troy, N. Y.
Ross, John..Troy, N. Y.
Rourk, I. W.........................13 Prospect street, Jersey City, N. J.
Russell, F. D.................................Box 65, Rochester, N. Y.
Russum, T. B..Hillsdale, N. J.

St. John, W...................................160 Broadway, N. Y. City.
Sanford, J. W.......................................Jersey City, N. J.
Sargent, W., Jr....................903 Havemeyer Building, N. Y. City.
Saunders, Theo................................13 Astor place, N. Y. City.
Saunders, William L.......................26 Cortlandt street, N. Y. City.
Sawyer, Nat.............................647 Eighth avenue, N. Y. City.
Sawyer, Edward C......................................Syracuse, N. Y.
Sayer, Frank T............................Warwick, Orange Co., N. Y.
Schanze, C. A.......................................Jersey City, N. J.
Schenck, R. C...Dayton, O.

Schlegel, Charles....................267 Tonnele avenue, Jersey City, N. J.
Schoen, C. T..Pittsburgh, Pa.
Schumann, John H.......................179 Penn street, Brooklyn, N. Y.
Seabury, Charles B..........................87 Maiden lane, N. Y. City.
Seguine, W. P......................202 Pacific avenue, Jersey City, N. J.
Sewall, J. H......................100 Exchange street, Worcester, Mass.
Sharpe, A. D..............................56 Beaver street, N. Y. City.
Sheffer, E. B.............................21 Cortlandt street, N. Y. City.
Sheldon, J. H.............................143 Liberty street, N. Y. City.
Simoes Cravo, Senor Francisco..................Rio de Janeiro, Brazil.
Sinclair, Angus...............................256 Broadway, N. Y. City.
Sisson, S. M.............................118 East 42d street, N. Y. City.
Slack, Frederick T...................Grand Central Station, N. Y. City.
Slack, John R......................................Dobbs Ferry, N. Y.
Sloan, George B., Jr..........................29 Broadway, N. Y. City.
Sloane, G. B..Oswego, N. Y.
Smilie, G. W.........................338 Mulberry street, Newark, N. J.
Smith, A. D..Weehawken, N. J.
Smith, C. A...................................26 Broadway, N. Y. City.
Smith, Cyrus T......................42 South Fifth avenue, N. Y. City.
Smith, Frank P......................................Doylestown, Pa.
Smith, G. De Witt...................................Roseville, N. J.
Smith, H. H...................................257 Broadway, N. Y. City.
Smith, John Y.......................................Doylestown, Pa.
Smith, Pemberton....Room 9, German Insurance Building, Buffalo, N. Y.
Smith, S. D..........................138 West 104th street, N. Y. City.
Smith, T. Guilford..................................Buffalo, N. Y.
Snow, F. W...Hillburn, N. Y.
Snow, F. William...................................Hillburn, N. Y.
Snow, W. W..Ramapo, N. Y.
Snyder, H. C..Newark, N. J.
Somers, J. E..........................294 First street, Brooklyn, N. Y.
Spadone, H. E.............................35 Warren street, N. Y. City.
Sprigg, W. O.....................................St. George, N. Y.
Sprowl, N. E....................................Phillipsburg, N. J.
Staples, Max E.......................Foot of Duane street, N. Y. City.
Staples J. B..... ....Jersey City, N. J.
Stevens, M. P..................Grove and 10th streets, Jersey City, N. J.
Stevens, W. N...........................53 Oliver street, Boston, Mass.
Stewart, J. B.......................West 42d Street Ferry, N. Y. City.
Stoutenger, F. G...................................Carbondale, Pa.
Streisher, Charles.................................Jersey City, N. J.
Strong, George S...............................1 Broadway, N. Y. City.
Summers, A. C.......................West 42d Street Ferry, N. Y. City.

Talbot, E. H..................................29 Broadway, N. Y. City.

Tarbush, James H.....................Harlem River Station, N. Y. City.
Taylor, Charles H..........................52 Broadway, N. Y. City.
Taylor, H. D.................................South Easton, Pa.
Taylor, W. H.................................Stroudsburgh, Pa.
Terbell, J. B....................................Corning, N. Y.
Thatcher, W. A......................Havemeyer Building, N. Y. City.
Thomas, D. H................................Hokendanqua, Pa.
Thomas, R. L.......................................Newark, N. J.
Thompson, A. W......................792 Broad street, Newark, N .J.
Thompson, Watson.................................Brooklyn, N. Y.
Thompson, C. A.... ....Jersey City, N. J.
Thurber, John L..........................178 Fulton street, N. Y. City.
Thyberg, Gustave....................261 Alexander avenue, N. Y. City.
Tilden, Burt E...Chicago, Ill.
Tooth, Henry W..........................Nicetown, Philadelphia, Pa.
Tratman, E. E. Russell................103 Tribune Building, N. Y. City.
Trautwein, A. P.................................Carbondale, Pa.
Travis, H. J...........................17 East 108th street, N. Y. City.
Tully, A. C............................106 West 51st street, N. Y. City.
Turner, John S.....................................Elkins, W. Va.
Twining, E. H. B..........................Times Building, N. Y. City.
Tyler, W. C..................................189 Broadway, N. Y. City.
Tyerell, Thomas......................................Clifton, S. I.

Valentine, N.......................917 Havemeyer Building, N. Y. City.
Valk, Louis...............Marcy and Flushing avenues, Brooklyn, N. Y.
Vancil, E. E........................909 Havemeyer Building, N. Y. City.
Vanderbilt, E. W..........................120 Liberty street, N. Y. City.
Van Frank, W. A......................................Elmira, N. Y.
Van Keuran, G....................................Carbondale, Pa.
Van Schaick, C. De F.................Grand Central Station, N. Y. City.
Van Tassell, G..................................White Plains, N. Y.
Van Woert, C. L...............................363 Broadway, N. Y. City.
Van Zile, H. L.............................136 Liberty street, N. Y. City.
Veghte, Augustus.......................................Troy, N. Y.
Vogle, Bernard.................................Green Island, N. Y.
Vonbuskirk, J. H.....................Grand Central Station, N. Y. City.
Vreeland, H. H...N. Y. City.
Vreeland, J. H...................................Rutherford, N. J.

Waite, G. W......................................Jersey City, N. J.
Waite, J. C..Norwich, N. Y.
Wales, C. M...............................136 Liberty street, N. Y. City.
Walters, Harvey............................840 Eagle avenue, N. Y. City.
Ward, John E................................6 Bridge Stores, N. Y. City.
Waterman, H. L...............................44 Wall street, N. Y. City.

Wattson, W. G........................West 42d Street Ferry, N. Y. City.
Weiss, George L....................139 Ingleside avenue, Cleveland, O.
Wells, O. Chan...........................29 Gold street, N. Y. City.
West, G. W.......................................Middletown, N. Y.
Wharton, Clifton......................Havemeyer Building, N. Y. City.
Wheatley, W. W.................................Weehawken, N. J.
Wheeler, E. Stearns..............................Saugatuck, Conn.
Wicks, John H....................................Tarrytown, N. Y.
Willetts, Warren J.............................Three Rivers, Mich.
Williams, C. C...................109 Plymouth street, Jersey City, N. J.
Wilman, L. D..................................South Norwalk, Conn.
Wilson, George P..................418 Walnut street, Philadelphia, Pa.
Wilson, William M...............Western Union Building, Chicago, Ill.
Winslow, Albert G.................................Jersey City, N. J.
Wise, Eugene A.......................301 West 138th street, N. Y. City.
Wood, F. W..............................197 Pearl street, N. Y. City.
Woods, C. M.........................Havemeyer Building, N. Y. Ciy.
Woods, J. L................................Box 1714, N. Y. City.
Woolsey, T. B............................363 Broadway, N. Y. City.
Woolson, O. C......................................Newark, N. J.
Wright, E. J..........................684 East 139th street, N. Y. City.

Ximeno, Senor Alberto...Habana.

Yereance, W. B.....................Foot of West 42d street, N. Y. City.

Zehnder, William D...................................Lebanon, Pa.

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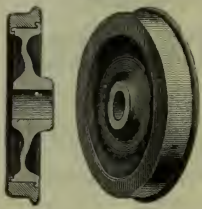

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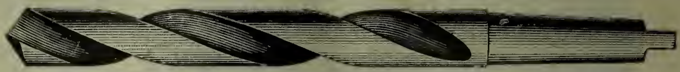

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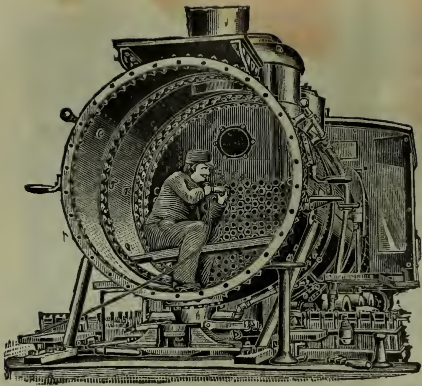

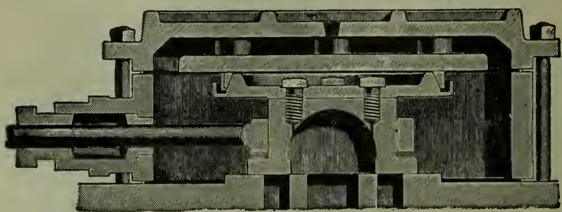

Meeting of February 20, 1896.

New York Railroad Club

SUBJECT:

Report of the Committee on Large Cars.

Published by the Club.
W. G. WATTSON, SECRETARY, FOOT WEST 42D ST., NEW YORK.

New York Railroad Club.

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R. M. DIXON,

Engineer, Safety Car Heating & Lighting Co.

D. M. BRADY,

Brady Metal Company

PROCEEDINGS

OF THE

New York Railroad Club.

Meeting held at the Rooms of the American Society of Mechanical Engineers, 12 West Thirty-first Street, New York, on Thursday Evening, February 20, 1896.

The President called the meeting to order at 8:20 P. M.

Members present, 89.

On motion the roll-call was dispensed with.

Secretary Wattson read the Minutes of the previous meeting, Thursday, January 16th, and they were accepted as read.

No reports of committees except that of the special one, on "Large Cars."

No unfinished business.

No new business.

President West stated that advance copies had been printed of the Report of the Committee on Large Cars. The report was read in abstract. The full text of the report is as follows:

To the President and Members of the New York Railroad Club:

Your committee, appointed at the October, 1895, meeting, to consider the so-called "large car problem," respectfully reports that it has held several meetings, and has conducted a correspondence with representative men in different departments of railway service, with the view of obtaining their opinions, based upon a varied experience with large and small cars. In order to enhance the value of its report, to those upon whom will devolve the ultimate determination of the limit of the maximum dimensions and capacity of freight cars, your committee is pleased to include, in an appendix (see page 17), as many of these expressions of opinion as is warranted by the time and space at its disposal. Your committee desires to express its grateful acknowledgments to all those who have favored it with replies to its communications. Covering, as they do, nearly all the different phases of this very intricate question, these replies should prove of great value to our club, and to railroad managements, in the intelligent and comprehensive consideration of the subject.

The committee understands that the present consideration of the so-called "large car problem" proceeds not alone from the standpoint of one department of railway service, but from that of all the principal departments; that it refers not only to economical transportation, from a traffic or operating standpoint, but also to the economic, as well as the physical, limitations upon the use of larger cars from the standpoint of

the mechanical and the maintenance of way departments; that it refers not only to box cars, but to other kinds of cars; that it refers not only to the future construction of cars, and the standardizing of the parts, but to the ways and means of utilizing to the best advantage the present equipment of varied dimensions and capacity.

Within twenty years the capacity of the average freight car has been increased three-fold. For many years, say from 1855 to 1876, the standard capacity of freight cars was 20,000 pounds. About 1879, the principal East and West trunk line roads commenced to construct cars to carry 40,000 pounds. About 1883 the 50,000 pounds capacity car made its appearance, and about 1889 some roads commenced to build cars of 60,000 pounds capacity, which is now considered the standard. But within the past year the L. S. & M. S., N. Y. P. & O., the Pennsylvania Company, and perhaps a few others, have added some 80,000 pounds capacity coal and ore cars to their equipments. The committee is not aware that any box cars of a greater capacity than 60,000 pounds have been constructed.

WHAT HAS BEEN THE CONTROLLING REASON FOR THE EVOLUTION FROM SMALL TO LARGE CAPACITY CARS?

The reason for the building of larger capacity cars each year is certainly not to be found in any concerted action or agreements between the railroads, brought about by an irresistible public demand. Neither is it to be found in the rules and regulations which the Master Car Builders' Association has adopted, prescribing the conditions under which the interchange of cars shall be carried on.

The reason for the building of cars of greater capacity year after year is also not to be found, exclusively, at least, in the fact that the previous or the existing freight classifications make no distinction (in the minimum carload weights for which shippers must pay) between cars of large and small capacity. Undoubtedly this has been the factor that has created a strong public demand for larger cubic capacity box cars in the transportation of light and bulky articles, and this demand has stimulated railroads to build such cars.

It must be remembered that the building of larger capacity cars has not progressed exclusively in the interest of certain light and bulky articles, such as furniture, vehicles, wooden-ware, straw goods, general merchandise, etc., but has been especially marked in the construction of cars for carrying heavier freight, such as coal, ores, grain, stone, lumber, castings, machinery, etc.

The main reason for the continued growth of car capacity is found in the necessity for increased economy in the transportation of freight. One of the best understood principles of railroad economy, about which there can be no dispute, is that of moving a given quantity or a given tonnage of freight with the fewest possible number of cars, and the fewest possible number of trains, within, of course, certain reasonable limitations. A

pertinent point for consideration at this time is whether the modern freight car has now reached the maximum profitable limit of its dimensions and carrying capacity, from an economic standpoint. The following table, showing, since 1876, the relative increase in dead weight of car and weight of paying load, and the percentage of each to the total loaded weight, may be of assistance in arriving at a conclusion:

YEAR.	Dead Weight of Car. Lbs.	Weight of Paying Load. Lbs.	Total Weight Loaded. Lbs.	Weight of Car. Percentage of Total. Per Cent.	Paying Load. Percentage of Total. Per Cent.
1876	20,500	20,000	40,500	53.62	46.38
1882	24,000	40,000	64,000	37.50	62.50
1889	27,700	60,000	87,700	31.59	68.41
1895	36,000	80,000	116,000	31.04	68.96

Assuming that these cars are loaded to their full carrying capacity, the benefit of the large increase in the proportion of "paying load" to "total load," and the large decrease in the proportion of "dead weight" to "total load," is too obvious for comment. It seems, however, from a careful study of these figures, to be hardly probable that any further advantage can be gained in the construction of wooden cars of a greater capacity than 70,000 or 80,000 pounds, because of the necessity of increasing the size and strength of the parts, which will add greatly to the proportion of dead weight, and decrease the proportion of paying load. Future development must undoubtedly come from the increased use of metal in car construction, by which it may be possible to further increase the paying load and decrease the percentage of dead weight.

FROM THE STANDPOINT OF OPERATION.

The economy of large cars depends, of course, upon the extent to which they can be made to carry full loads, keeping the proportion of dead weight at the minimum. It must be admitted that in this respect there is some difference between box cars and open cars, owing to the distinctive characteristics of the traffic to which they are adapted. The usual arguments in favor of large capacity cars may be applied unreservedly to those cars that habitually move with full loads, and only to a limited extent to those cars that frequently carry light loads which do not reach the limit either of cubic or tonnage capacity.

The open cars habitually carry full loads in one direction and nearly always move empty in the opposite direction. Of the total mileage of open cars probably 46 per cent. is empty mileage. Covered cars sometimes move in one direction with loads which do not fill either their cubic or their tonnage capacity; but in the matter of dead weight to paying load there is a compensating consideration in the fact that they are frequently given return loads. Of the total mileage of covered cars probably not more than

20 per cent. is empty mileage. Of all the loaded covered cars it is safe to say that (exclusive of cars in strictly local traffic) about 85 per cent. are fully loaded, either to the limit of their cubic or their tonnage capacity, and about 15 per cent. will average nearly one-third of a full load. The light loading is usually in the contrary direction to the movement of heavy traffic. While it is true that the light loading is confined almost exclusively to box cars, it must be remembered that box cars are not confined exclusively to light loading. To a very large extent they engage in the movement of full loads, both of light and of heavy freight. When box cars, and other roofed cars, are used for shipments of heavy freight, such as grain, coal, coke, lumber, flour, sugar, liquids in barrels, nails, rails, castings, etc., and when they are used for full loads of the light and bulky class of freight, such as furniture, carriages, hay, etc., there is an undoubted advantage in the strong, large capacity cars.

Upon certain classes of light and bulky articles the carrying capacity of cars is limited by the dimencions of the car bodies, in other words, by the number of cubic feet of inside space available for storing away the property. When carrying full loads of light bulky freight, the cars may be loaded to the limit of their cubic capacity, and yet be far below the limit of their tonnage capacity. Taking the freight traffic of the country as a whole, about 25 per cent. of the total tonnage is of such character that a full car load does not reach the limit of weight capacity.

Upon other classes of freight the carrying capacity of the cars is limited, not by the dimensions of the car bodies, but by the strength of the axles, the running gear, the car bodies, and frames, and by strength of the permanent way, bridges, etc. With such heavy freight the cars may be loaded to the limit of their tonnage capacity; but when covered cars are used there is a large proportion of their cubic capacity unfilled. About 75 per cent. of the total tonnage is of such a character that it may be loaded up to or beyond the full weight capacity of the cars. (See table No. 3, Appendix page 19.)

The 25 per cent. of tonnage of light and bulky freight is carried mostly in covered cars, and the 75 per cent. of tonnage of heavy freight is carried mostly in open cars, although, as previously stated, the covered cars engage more or less in its movement. The bulky freight frequently, but not always, moves in small lots, and the difficulty of making full carloads in such cases is to get several small lots on the same day, going to the same destination. The heavy freight usually moves in large quantities, making it easy to get full carloads for the same destination.

Notwithstanding the unequal percentage of the tonnage of light bulky freight to heavy freight, it seems from the summary of the total car equipment of the United States, that we have about an equal proportion of covered cars and open cars.

Box cars (including refrigerator and furniture cars) constitute about 47 per cent., and open cars about 48 per cent. of the total equipment, the remaining 5 per cent. being stock cars. The reason that we require a greater number of covered cars in proportion to the tonnage of light,

bulky freight, than of open cars, in proportion to the tonnage of heavy freight, may be explained in three ways, viz:

1. Because the average loads of the covered cars are lighter than of open cars.

2. Because the covered cars are delayed longer in unloading and loading, and are frequently held weeks and months for prospective return loading.

3. Because the covered cars are not confined exclusively to the light, bulky freight, but engage more or less in the movement of heavy freight.

It has often been said that, on some roads, where light, local freight chiefly predominates, which must be handled in small lots, and with great despatch, small capacity, light weight cars can be used with greater facility and with greater economy. This is one of those special local problems which any road so situated must determine for itself. In case the small capacity, light weight cars are used, they should not be permitted to go into the general interchange with other roads, but should be kept strictly in the local service of their owners. Naturally, any road contemplating an experiment of this character with small, light cars, will consider the probability that it will have to handle them in separate trains, as it is well known there are elements of danger in handling mixed trains of large heavy cars and small light cars; and that it may frequently be necessary to move the small light cars empty in a contrary direction to the usual movement of empty cars, thus increasing the percentage of empty car milage.

The process of selecting and switching the small cars, to get them in place for loading, is another weighty consideration. Perhaps, all things considered, the use of small cars on main lines, where other cars are available, might result in hauling a greater proportion of dead weight to paying load than if the available large capacity cars were used for all classes of freight. But on branch lines, which serve a purely local constituency, and do not engage freely in the general interchange, it is conceivable that the small cars may be more economical.

It has been said that each railroad may have special problems of its own to be solved according to the characteristics of its traffic and other existing conditions, and may insist upon solving its special problems in its own way. The force of this argument would be overpowering provided the railroad that builds cars precisely suited to its own requirements would keep them at home to be used strictly in its local service. This point, however, has only a limited application to our subject in its broader acceptation. The committee understands the present consideration of the subject to refer especially to cars that are to be used in the general interchange service, and such cars, as is well known, wander about over the whole country.

When a railroad builds cars for general interchange with all other roads it must manifest some regard for the characteristics of the traffic and other existing conditions of the whole railway system. In the transportation

business of the country the identity of certain railroads is slowly but surely disappearing. They are gradually merging their individuality into the body of the great transportation system considered as a whole. Although it is assumed that cars are built primarily for the use of the road owning them, they cannot, under present conditions, be kept exclusively in the possession of their owners. The interchange of cars is a reciprocal function, and the owner receives a large number of foreign cars in exchange for his own. No railroad has the right, or should be permitted to assume the right, of building cars specially adapted to its own conditions of service, but not adapted to the conditions of service on other roads, and then send them abroad in the general interchange expecting other roads to haul them long distances empty for return to owners.

The aim should be to build cars adapted to the general service on all or a majority of the principal railroads. In the hauling of through freight each railroad forms part of a through line. Each road forming part of such a through line has a right to demand that the cars of other roads which it receives in exchange for its own shall conform to some accepted standard, suited to the general requirements of the through traffic. Certainly each road can afford to accept a compromise standard which, if not exactly in accordance with the individual ideas of its officers, will at least do away with the many evils that are admitted to surround the use of a multitude of standards. The desirability of uniformity in dimensions of parts and their interchangeability have been so often referred to and recommended that further comment is superfluous. No economical reform can be more important than this.

The operation of cars specially adapted to the local conditions of only one or two roads, and confined exclusively to one class of traffic, requires a large amount of extra switching and a vast amount of empty haulage to get them into position for loading, which is an expensive incident. It is very desirable to decrease the percentage of unproductive empty car mileage which now amounts to about one-third of the total car mileage. If oil tank cars could be adapted to hauling return loads of other freight, if stock cars could be adapted to other freight than live stock, if the large furniture cars could be strengthened so that they might be used frequently for heavy freight instead of being confined exclusively to light and bulky freight, if ordinary box cars could be slightly increased in cubic capacity so as to be used frequently for the light and bulky freight, it would be a distinct gain in economical transportation.

From the standpoint of operation, economy demands that the number of tons of paying freight drawn by each engine shall be increased, because all of the expenses chargeable to operation will then be spread over a greater number of tons. In order to increase the tonnage of paying freight per engine or train, it becomes of importance to reduce, as much as possible, the number of tons of dead weight. Apart from the decreased original first cost and the decreased cost of repairs of the smaller number of cars and engines, it is obvious that the cost of hauling 1,200 tons of

paying freight 100 miles in forty cars, with one engine and train crew, is much less than the cost of hauling the same tonnage the same distance in eighty cars with two engines and two train crews. The more the number of cars and the number of trains are multiplied for moving a given tonnage of paying freight, the greater will be the share of expenses which will fall to each ton transported. This is a strong point in favor of the use of large capacity cars. That it is generally believed to be well grounded is shown by the steady increase in car capacity of all classes of cars for the past twenty years.

Instead of hauling such a great proportion of dead weight in such long trains, which are hard to handle, and are often destructive to themselves, the tendency of the future with metal construction is likely to be to haul the same or an increased revenue tonnage concentrated in fewer cars and shorter trains. Such an evolution will accomplish the following desirable results, viz:

1. Reduce the friction and the atmospheric resistance.

2. Bring the moving load nearer to the engine, so that it can be more easily handled than in a long train.

3. Reduce the empty car movement in the direction contrary to the heavy traffic stream.

4. Reduce the number of cars and the number of locomotives for moving a given tonnage.

5. Reduce the switching service.

6. Reduce the payments for car mileage and the cost of inspection and repairs in proportion to the tonnage moved.

7. Increase the traffic capacity of main lines, of freight yards, and terminals without building more main tracks and sidings.

FROM THE TRAFFIC STANDPOINT.

Traffic considerations, strictly speaking, have little to do with the determination, from an economic standpoint, of the dimensions and capacity of freight cars. Of course, freight cars must be adapted to the traffic they are intended to carry, but the question of their adaptability does not rest with the traffic department. Knowing the characteristics of the traffic to be moved, the questions pertaining to the construction, operation and maintenance of cars are generally determined by the mechanical and operating departments.

It seems, however, that traffic considerations are involved in obtaining the best possible service from our present ill-assorted freight equipment. This is especially the case with box cars, but has only a limited application to other kinds of cars. The existing great diversity in the dimensions and cubic capacity of box cars has made the traffic side of the large car problem a factor of greater consequence than was originally desired or intended.

A principal function of the traffic departments is the making of rates and classifications. The ostensible object of the freight classification is

to establish such a definite relation between the various classes of property offered for transportation that no preference shall be given one over another. But after establishing such a relation between various articles in their classification, the traffic officials have gone further, and have determined, with respect to certain light and bulky articles, what shall be considered the nominal minimum carload. In many cases the minimum carload is not what the ordinary box car will hold, but two or three times what can be put into it. An extra big carload at the minimum carload rate is, of course, cheaper to the shipper than a small carload at the same rate. Whether a given carload rate is considered by the shipper as high or low depends in such cases upon the size of the car offered by the carrier.

A form of competition extensively indulged in by the carriers at the instigation of the traffic departments is the building of extra large box cars for the handling of light and bulky freight. The demand for these extra large box cars was inaugurated and is still being stimulated by the provision in the official classification establishing minimum carload weights of light and bulky articles, for which shippers must pay whether the car offered by the carrier is a large or a small car. As the shipper who gets a small car knows he will have to pay more per 100 pounds or per package than the one who gets a large car, it is quite reasonable and natural that all shippers of light and bulky freight should demand the largest cars to be had. This demand will doubtless continue until the classification is changed.

The simple and natural remedy for this would seem to be the establishment of a rate unit for light and bulky articles that will make no discrimination between the use of small and large capacity cars. So many difficulties surround any radical change of the classification that it has been decided to proceed slowly and gradually. It has been proposed by traffic officials, and the proposition is now under consideration by the various traffic associations, to limit the existing minimum carload weights to cars of 34 feet in length, inside measurement, and to establish a sliding scale of minimum weights, increasing for cars over 34 feet and decreasing for cars under 34 feet in length, upon the basis of the proportionate weights per foot of 34 foot cars under the present minimum weights. For instance, when the minimum carload weight provided for any article, if loaded in cars 34 feet in length, is 20,000 pounds, it is proposed to deduct 600 pounds for each foot of length of car less than 34 feet, but not less than 30 feet in length; cars under 30 feet in length to be charged the minimum carload weight applicable upon cars 30 feet in length. Likewise, when the minimum carload weight provided for any article, if loaded in cars 34 feet in length, is 20,000 pounds, it is proposed to add 600 pounds for each foot of length of car more than 34 feet, actual weight to be charged for when in excess of the minimum weight.

It will be seen that the proposed sliding scale of minimum weights is based solely on the varying lengths of cars. It does not take into consid-

eration the evident fact that cars of the same length often vary widely in their cubic capacity, the difference being in the width and height. From a traffic standpoint, in the handling of light and bulky freight, the width and height of box cars is of quite as much importance as their length. Your committee is of the opinion that the basic factor of the sliding scale of minimum weights should be, not the length of the cars, but, their actual inside cubic capacity, as suggested by Commissioner J. F. Goddard. In order to make this opinion of any practical value it is necessary that all box cars have their cubic capacity stencilled on the sides in the same manner as their tonnage carrying capacity. Your committee strongly recommends that this be done, and suggests that this recommendation be made effective by the passage of a resolution in the Master Car Builders' Association and the American Railway Association. It is one of those minor details, so easy of accomplishment, and so inexpensive, that there can be no valid objection to it.

CONSTRUCTION AND MAINTENANCE.

When we come to consider the subject from a constructional standpoint, it may safely be said that there is no upper limit of the possible capacity of cars to safely carry their loads. Given the burden to be transported, and the car builder will be ready with the car, and if eight wheels are insufficient to properly distribute the load, he will use all that may be required, as in the case of the Krupp gun car of the Pennsylvania Railroad, that has a capacity of 170,000 pounds, and which is carried on thirty-two wheels. But we are not considering this type of car. Our subject is naturally limited to cars that are used in the every day traffic of railroads, and for which loads are ordinarily in waiting. With this type of car, too, we may again say that there is no upper limit of possible capacity so far as the demands of the immediate future are concerned, but of certain types of this car it is very evident that the limit of good construction has not only been reached, but, in many instances, has been passed.

For an all wooden car, with bolsters of the same material, it is doubtful if a substantial car of more than 40,000 pounds capacity can be constructed within the limits of space available. Not but that cars of greater nominal capacity than this have been built, but as far as the observations of your committee is concerned, they cannot be called satisfactory.

The bolsters of such cars invariably yield, and the pressure upon the side bearings becomes very high, as evidenced by the difficulty with which the trucks under such cars curve, and the sharp flanges that are caused by this curving resistance. With the yielding of the body bolsters, the truss rods are slackened, and the support to the center of the framing destroyed, with the inevitable result that the sills sag, for they will always yield enough to put a strain upon the truss rods. The bolster problem has, therefore, become a question of itself in the construction of cars of high capacity, and increases in difficulty of solution as the width of the car is increased. That car builders realize the situation is shown by the large

number and variety of designs exhibited in the bolsters of recent cars; some of which display a desperation on the part of the designer that is almost pathetic. In one case the weight of a truck bolster is said to be 1,100 pounds, evincing a determination to "get there" on the part of the car builder, and to keep those bearings clear.

If American car builders would turn back, and follow in the trail of their European confreres, who build a car with the side bearings in contact, possibly a wooden bolster might be made to serve, but in the opinion of your committee this would be exceedingly bad practice, since the inevitable result would follow that all of the load would be placed upon the side bearings until the bolster yielded enough to bring the center plates into contact, because of the well known difficulty of bringing three points in line into contact, especially in such rough work as we use in car construction.

Your committee would, therefore, recommend that on all cars of a capacity of more than 30,000 pounds, no wooden bolsters be used.

Passing this point of 30,000 pounds capacity, the car becomes composite in its construction, and is the first and natural step in the development of the iron car. The essential features of a satisfactory body bolster for a car of 60,000 pounds capacity, are that it should be stiff enough to carry the running strains imposed by a load of 30,000 pounds, plus one half the weight of the car, and not deflect enough to bring the side bearings into contact.

Turning from the bolster to the framing, we find that practice varies from road to road, and almost, it might be said, with the whim of the car builder. We find cars built with sills ranging from 4 x 8 inches to 5 x 14 inches, which in itself makes a variation of from 1 to 3¾ in their supporting power; and truss rods varying from four of 1 inch in diameter to six of 1½ inches diameter, and that, too, for cars of the same nominal capacity, showing that guesswork extends beyond the domain of the designing of the body bolster. It is the opinion of your committee that truss rods should be so proportioned that they are capable of carrying the whole of the static weight that would naturally fall upon them, and that the upper framing should have sufficient strength to sustain the extra stresses put upon the car while running.

It is evident that a few excessively large truss rods might be made to fulfill this function, but another element must be taken into consideration, and that is the crushing strength of the material used in the end sill. If the strain on the rod is so great that the pressure per square inch beneath the washer exceeds the resisting power of the wood, the latter will yield and the rod be slackened by the working of the washer into the end sill. Instances have been observed where the washer had cut half way through the end sill. Thus we find ourselves hedged in in another direction in our attempt to increase the capacity of our cars, for excessive strains upon the body truss rods call for metal in the end sills or another step towards the adoption of an iron or steel car.

Cars rating from 60,000 pounds to 80,000 pounds capacity may be roughly divided into two broad classes, the gondola and the box. The strengthening of the gondola car is comparatively easy. The sides may be made to form a plate girder running from end to end of the car, and thus become a very important element in the strength. The boards should be very carefully and truly fitted to each other along their edges, bolted together by through bolts and held down to the sills by strap bolts. We would also suggest that such cars would be stronger if the side boards are made to have a bearing against the sills, rather than upon the top of the flooring as usually constructed. The flooring interposes a factor of weakness, by breaking the integrity of the depth of the girder, while, by bringing the side boards down against the sill, the working depth of the girder is increased by the depth of the said sill. Where the side boards are loose and can be turned down, the greater portion of the advantage otherwise gained is lost. With gondola cars, then, difficulties of designing are insignificant, and can be readily overcome by careful workmanship.

With box cars, the problem is one of an entirely different character. We have an upper framing broken at the center so that the lower framing must be called upon to withstand the major portion if not the entire strain induced by the load when running. For a car of 70,000 pounds capacity your committee would recommend the use of at least six truss rods of 1½ inches in diameter, dropping down from a point just beneath the flooring over the body bolsters. The king-posts at the cross-tie timbers should stand at an angle so as to exactly bisect that formed by the horizontal and inclined portions of the truss rods; the cross-tie timbers should be braced to withstand the horizonal thrust of the king-posts and the sills should measure at least 5 x 9 inches.

The upper framing of the car can be made so that theoretically it will carry a portion of the load, but when we examine the average contract work, note the shrinkage of the timber, the loose joints thus engendered in addition to those originally existing, it becomes evident that, while a droop in the lower framing may bring the upper works into service, the latter cannot be depended upon to hold the car in its original shape, and that the truss rods should be the main reliance.

While we do not know the actual running stresses imposed upon a car, we do know that these stresses probably vary with the material with which the car is loaded. Thus we would expect a car loaded with 60,000 pounds of pig iron to sustain greater stresses than one loaded with 60,000 pounds of coke; the bulk of the lighter material serving to cushion the stresses it imposes, just as a stevedore "diamonds" a cargo of bar iron, lest, if it be stowed solidly in the hold, the vessel whip her masts out in the first storm.

Regarding the desirable length of cars, it appears to your committee that for wooden framing, a length of 36 feet inside ought not to be exceeded. Of iron framing, we are not in a position to speak. Your committee has not regarded it as falling within its province to design an iron car, but thinks that, if it is found to be economical to increase the capacity of cars

from the standpoint of the traffic department, the all iron or all steel car will be the one that will be put into service.

The bracing for side strains is a matter to which careful attention has been paid, and the recommendations of the committee on coal car sides reporting at the last convention of the Master Car Builders' Association will undoubtedly be found to be ample to cover the case. For grain cars the side posts should be carefully fastened to the plates and sills, and the former rigidly stayed by the car lines while additional strengthening at the belt rail is advantageous.

Observation of the amount of repairs required by these large cars indicates that the proper proportional strength of high cars has not been attained, particularly where the cars are more than 34 feet long. Wide cars also develop many weaknesses, especially in the bolster where the width is more than 9 feet.

The trucks to be used under these large cars is a matter of great importance, and is receiving constant attention; in fact, truck construction has outstripped the body construction, so far as strength is concerned, to such an extent that it requires but a passing notice at the hands of your committee. The steel bolsters and transoms used seem to be fully up to the requirements of the traffic; but there is an evident desire to secure something better than the diamond truck. This is shown by the rapidly increasing use of the present steel construction. Where the diamond truck is retained it appears to your committee to be desirable to use a lighter column bolt than the one now employed, and secure the requisite strength at that point by U bolts on the outside of the arch cars. This avoids cutting away metal at a point where it is especially valuable, and enables a 1¼ x 4 inch bar to be used for heavier loads than those for which it is now suitable.

It seems to be the opinion of engineers in charge of the permanent way, that the wheels of heavily loaded cars do more damage to the track than those of a locomotive, despite the destructive hammer blow that is supposed to accompany the latter; a condition that is probably due to the greater likelihood of the existence of flat spots on car wheels.

Your committee considers the use of a central truck inadvisable except in special cases. It is better to increase the capacity of a car by placing a center truck in position than by the unaided use of the paint pot, and it is well known that such trucks are in successful operation; but in designing cars for ordinary traffic it will probably be found to be more satisfactory to use two trucks, resorting to the use of six wheels if necessary.

From the view-point of car maintenance, it may be well to consider to what extent the cost of repairs per freight car per annum has increased since the maximum load carried has been increased from 20,000 to 60,000 pounds. If there has been any considerable increase in the cost of repairs it would be of value to know whether the increase is of a greater or lesser percentage than the increase of load carried. Does it cost twice or three times as much for repairs of one 60,000 pounds capacity car as it does for one of 20,000 pounds capacity? To determine fairly the relative expense

of maintenance of two classes or standards of cars, so as to compare one with the other, it is important to ascertain what is the correct unit or basis of comparison. Shall we simply compare one car with another without regard to the performance or usefulness of either? Shall the unit of comparison, as is now usually the case with locomotive expenses, be the number of miles run? The real test of efficient car service, as it should be with locomotive service, can be nothing else than the tonnage moved or the revenue earned. Your committee is of the opinion, though no actual data is available, that the expense of maintenance per car per ton hauled is not increased, but, on the contrary, is much diminshed by successfully carrying 30 tons instead of 10 tons in one car.

Finally, we must consider an element touching both the operation and construction of large cars. It has been shown that brakes are best adjusted when the pressure of the shoe against the wheel is 70 per cent. of the weight of the wheel upon the rail. As this adjustment must necessarily be made for an empty car, it follows that the braking efficiency falls as the load in the car increases. If a car weighing 30,000 pounds can be stopped in 600 feet when empty, it will run approximately 1,200 feet with a load of 30,000 pounds, and 1,800 feet with 60,000 pounds, so that the speed of the loaded train must necessarily be lower than the empty one, if the same control is to be maintained.

As a resumé to this portion of the report, your committee would recommend, that for cars of 60,000 pounds capacity and over, it is best not to exceed a length of 36 feet inside measurement; that the main dependence for the vertical strength of box cars should be placed in the truss rods; that steel bolsters should invariably be used, and that the side bearings should always have a clearance.

SHALL THE CUBIC CAPACITY OF ORDINARY BOX CARS BE INCREASED?

The old style 10 tons capacity box cars used twenty years ago were about 25 feet long, inside measurement, with about 48 feet of available cross-section, making a storage capacity of about 1,200 cubic feet, or about 120 cubic feet of storage capacity per ton of weight capacity. The present 30 tons capacity box cars are about 33½ feet long inside, with about 58 feet of available cross-section, making a storage capacity of about 1,943 cubic feet, or about 65 cubic feet of storage capacity per ton of weight capacity.

Although the storage capacity has been increased about 60 per cent. in twenty years, it will be seen that the weight capacity has been increased 200 per cent.; and that the cubic feet of storage capacity per ton of weight capacity is now only a little more than half of what it was. The factor which should now determine, with respect to ordinary box cars, whether it is economically desirable to further increase their storage capacity, is the relative proportion of full car loads of light bulky freight and of heavy freight, which they usually carry. Of course, the conditions vary on different roads, but there is no question that the correct principle is the

adaptation of the standard box cars to the average conditions of service on all roads.

Your committee has already stated that about 85 per cent. of all loaded box cars in through service are fully loaded, either to the limit of their cubic, or tonnage capacity. No reliable figures are available to show what proportion of these fully loaded cars contain light bulky freight, and what proportion contain heavy freight. Your committee believes, however, as the result of its observation, that the character of freight usually handled in box cars is such that the load carried is limited quite as often by the cubic capacity as by the weight capacity.

The proper conclusion from these premises seems to be that in order to reduce the empty car mileage, and to keep up a paying circulation of box cars in the general interchange, they should be adapted to handle either class of freight. To logically apply this idea in practice is to do away with the existing double standard of box cars—one for the light bulky freight and another for the heavy freight; and to fix upon a single standard that shall be available for all classes of through freight. This being the case, it appears to be desirable to slightly increase the storage capacity of our ordinary box cars to make them available in a larger degree for the transportation of full loads of the light bulky freight, so as to stop the building of special sizes of furniture or wagon cars.

The increase in the storage capacity of ordinary box cars may be accomplished by increasing either the available cross-section, or the length, or both. If they are to be adapted to the carriage of heavy freight, no great increase in the length with wooden construction is permissable, and the increase in the cross-section is also limited. It therefore becomes of great importance to know, first, what is the maximum cross-section of roofed cars that will pass freely in the general interchange; and second, having agreed upon a standard weight capacity for roofed cars, to know what is the maximum length of span over which the moving load can be supported. While the second factor may depend largely upon the design, and the strength of the materials used in construction, and may be greater for metal than wooden construction, the first factor may be determined with considerable accuracy.

CONCLUSIONS.

On page 17 of this report, included in the appendix, will be found table No. 1, giving the maximum clearance dimensions which limit the size of cars on various roads. These clearance dimensions vary widely, being greater, as a rule, on western roads than on eastern roads. In this, as in other matters, the aim should be to make the standard car of such dimensions as will suit the general conditions of clearance. After a careful review of the above-mentioned table, the members of the club will doubtless agree with the conclusion of the committee that, for free interchange on the majority of roads, the maximum outside cross section of cars should in no case exceed the following:

From top of rail to top of eaves, 12 feet 3 inches.

Width, out to out, at eaves, 9 feet 10 inches.

With respect to length, some roads, notably the Pennsylvania lines east and west of Pittsburgh, specify, not to exceed 43 feet in length out to out of platform, and 31 feet center to center of trucks.

Your committee wishes to be understood that it does not recommend these dimensions as the standard for roofed cars, but submits the figures for the information of the club. There are a few roads, probably not more than half a dozen, that are unable to handle cars of these maximum dimensions, while all of the others can easily do so, with more or less room to spare. Some of the roads now have cars in their equipment that exceed these dimensions (as will be seen by table No. 2, in appendix page 18), but, when engaged in through service with other roads, their use is confined to such roads as is well known can handle them.

It is the opinion of your committee that the proposed standard car body for roofed cars, to make them equally available for the carriage of light bulky freight and heavy freight, should have an available inside cross section of not less than 65 feet, and not more than 75 feet; and an inside length of not less than 34 and not more than 36 feet. Within these limits the storage capacity would be from 2,210 to 2,700 cubic feet, the latter of which appears to be ample for any class of freight handled in box, stock or refrigerator cars. The outside dimensions of such car bodies, if mounted on standard trucks, with the floors at an equal distance above top of rail, would come easily within the limits of maximum clearance of all roads. Your committee finds that with cars of the same capacity, where the same kind of trucks are used, the present practice places the sills in some cases as low as 2 feet 3 inches, and in other cases as high as 3 feet 6 inches above top of rail, the difference being mainly in the method of placing the draw-gear. It is desirable that some agreement be had not only with respect to the size of the car bodies, but also with respect to the height above top of rail of their mounting.

From the traffic, as well as the operating and mechanical standpoints, it is quite as desirable to eliminate from the interchange service the small weak cars as it is to agree upon the maximum dimensions and capacity of the large strong cars. At the present time there appears to be no advantage in keeping the small weak cars in the interchange service. The damage inflicted by large strong cars upon much smaller and weaker cars when handled in the same train has been exemplified so often in past and present practice that the necessary moral may be drawn without further experience. The difference is so great between the revenue earning capacity and the cost of repairs of the old style small capacity cars and the modern large capacity cars that it is clearly unwise, as well as unfair, that one be interchanged for the other at the same rate of mileage or per diem.

The withdrawal from the interchange service of all four wheeled cars, and of all eight wheeled cars of a less capacity than 40,000 pounds, the committee thinks, would not be an injustice to any road; and with respect to

roofed cars, whose cubic capacity is a factor of consequence, the additional line for exclusion from interchange might well be drawn upon all cars of less than 30 feet in length, inside measurement, and of a storage capacity less than 1,500 cubic feet. The owners of the small cars could then keep them in local service on the home road during the short remaining period of their existence. To make this recommendation effective a suitable rule should be added to the Master Car Builders' rules of interchange. Such a reduction of the existing great diversity of cars in interchange should be one of the first steps towards the attainment of a standard car for general service.

The multiplication of standards for one class of cars is always objectionable, and should be discouraged, unless the compensatory advantages are indeed great. If they are intended to run together in the same train, it is evident that safety, as well as economy, precludes the idea of any large discrepancy in size and strength between cars of the same class, or of different classes. The evolution towards greatly increased strength and capacity of one class of cars should not, therefore, be permitted to proceed entirely regardless of the relative increase in the strength and capacity of another class. Some definite ratio should be maintained between them. With the possibilities of greatly increased strength and capacity arising from the extensive use of metal in future construction, it is obvious that these considerations will hereafter assume greater importance than at present.

For general interchange service there should be fixed by convention a minimum limit; and a maximum limit of weight carrying capacity for all classes of cars. Your committee has already recommended the withdrawal from interchange of all cars of a less carrying capacity than 40,000 pounds. Few, if any, cars of a smaller capacity have been built during the past thirteen years; and those of a smaller capacity now in existence are nearly worn out. In determining the probable economic limit of the relative maximum weight capacities of roofed cars and open cars, of wooden or composite construction, it is not apparent to your committee that much is to be gained by exceeding a capacity of 70,000 pounds for the former, and 80,000 pounds for the latter. Your committee, therefore, recommends that these maximum limits be agreed upon, and not in any case exceeded until the roads change them by further mutual agreement. If no cars of a greater capacity than 70,000 or 80,000 pounds are permitted to go into the general interchange, it is safe to say that the problem of the weights of loaded cars upon track and bridges will not become a disturbing factor.

Respectfully submitted,

W. W. Wheatly,
G. L. Fowler,
J. F. Moore,
Committee.

APPENDIX.

TABLE 1.

*Maximum Dimensions of Clearance of Various Roads Which Limit the Size of Cars.**

NAME OF ROAD.	Clear Height Above Top of Rail at Given Width.							
	At 8 Ft. Wide.		At 9 Ft. Wide.		At 10 Ft. Wide.		At 11 Ft. Wide.	
	Height Above Rail.		Height Above Rail.		Height Above Rail.		Height Above Rail.	
	Ft.	In.	Ft	In.	Ft.	In.	Ft.	In.
Allegheny Valley	13	3	12	6	11	6	..	..
Atchison, Topeka & Santa Fé	14	6	14	..	13	..	12	..
Atlantic & Pacific	..	..	..	..	12	..	..	..
Atlantic Coast Line	14	10	14	5	14	5	14	5
Baltimore & Ohio	13	6	13	..	11	9	..	..
Beech Creek.	..	..	..	..	16	..	15	..
Boston & Albany	15	..	14	..	12	6	..	..
Brunswick & Western	..	..	..	..	.	..	15	..
Buffalo, Rochester & Pittsburgh	15	9	15	..	14	6	..	..
Burlington & Missouri River in Neb	17	..	..	..	15	..	..	..
Canadian Pacific								
—Port Arthur to Donald	12	..	11	6	11	2	11	..
—Other Divisions (limit)	16	..	16	..	15	..	14	6
Central R. R. of New Jersey								
—Between Tamaqua & Scranton	12	6	12	..	11	4	..	..
—Other Main Divisions (limit)	14	..	13	10	13	10	..	..
Central, of Georgia, Railway	15	4	15	4	15	3	15	3
Chesapeake, Ohio & Southwestern	14	..	13	0	13	..	11	..
Chesapeake & Ohio	12	3	11	9	11	3	..	..
Chicago & Eastern Illinois	17	..	17	..	16	..	16	..
Chicago & Erie and N. Y. P. & O	16	..	15	6	14	6	11	3
Chicago Great Western	15	3	15	3	15	..	15	..
Chicago, Burlington & Quincy	14	4	14	4	14	4	14	..
Chicago, Milwaukee & St. Paul	14	9	14	9	14	9	14	3
Chicago & West Michigan and D. L. & N	16	..	16	..	16	..	16	.
Chicago, Burlington & Northern	18	3	18	3	18	3	18	3
Chicago, Rock Island & Pacific	14	4	14	..	13	8	..	..
Chicago & Western Indiana	16	9	16	9	16	9	..	..
Cleveland, Cincinnati, Chicago & St. Louis	14	6	14	6	14	6	14	6
Delaware & Hudson Canal Co	14	5	14	..	13	6	12	6
Delaware, Lackawanna & Western	..	..	..	..	12	11	..	..
Erie Railroad	13	6	13	..	13	..	11	..
Flint & Pere Marquette	16	..	16	.	16	..	16	..
Fitchburgh R. R	13	9½	13	2½	12	3¼	..	..
Great Northern	14	..	14	.	14	..	14	..
Grand Rapids & Indiana	..	..	14	..	14	..	..	..
Grand Trunk Ry. of Canada	..	..	..	..	..	..	14	..
—Welland Canal Tunnel	14	..	..	..	13	8	..	..
—St. Clair Tunnel	..	..	..	..	..	..	13	.
Grand Trunk Lines West of St. Clair Tunnel	..	..	..	..	..	..	14	..
Lake Shore & Michigan Southern	14	..	13	6	13	..	12	2
Lehigh Valley	13	7	13	1	12	7	..	..
Louisville & Nashville								
—Entire System, including branches (limit)	12	7	11	10	10	..	..	..
—Louisville to New Orleans and River Junc	14	9	..	..	14	..	..	..
—East St. Louis to Nashville and Bowling Green to Memphis	..	..	..	..	14	..	..	..

* Many roads can handle on one or more of their divisions or sub-divisions cars considerably in excess of the dimensions given. In such cases the Committee has given those clearance dimensions which appear to establish the limit, which, for the purpose in view, is all that is required.

NAME OF ROAD.	CLEAR HEIGHT ABOVE TOP OF RAIL AT GIVEN WIDTH.							
	At 8 Ft. Wide.		At 9 Ft. Wide.		At 10 Ft. Wide.		At 11 Ft. Wide.	
	Height Above Rail.		Height Above Rail.		Height Above Rail.		Height Above Rail.	
	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
Louisville, New Albany & Chicago............	15	..	15	..	15	..	15	..
Michigan Central.................	..	..	..	..	13	3	..	..
Mobile & Ohio........	17	..	17	..	17	..	17	.
Maine Central............	14	..	14	..	14	..	..	..
New England R. R..	13	9	13	9	12	2	..	..
New York Central & Hudson River..........	13	8	13	2	12	6	..	..
New York, Ontario & Western.................	13	9	13	3	12	6	12	..
New York, New Haven & Hartford...........	13	8	13	..	12	3	..	..
New York, Chicago & St. Louis R. R..........	16	9	15	..	15	..	..	..
Philadelphia & Reading.........	13	6	13	6	12	6	..	..
Pennsylvania Railroad........................	14	3	12	7	11	9	..	.
Pennsylvania Lines west of Pittsburgh........	14	6	14	..	13	6	..	..
Queen & Crescent.....	14	..	13	1	12	1	11	5
Richmond, Fredricksburg & Potomac..	15	..	14	6	14	..	13	6
Southern Ry....................................								
—McElroy Tunnel (between Salisbury and Ashville)	..	..	11	3	..	.	..	..
—All other divisions (limit)	13	1	12	3	11	2	..	..
Seaboard Air Line.........	16	..	16	..	16	..	16	..
Union Pacific	16	3	16	3	16	3	16	3
Wabash R. R.........	..	..	..	..	14	..	..	..
West Shore R. R........	13	..	12	6	12	6	12	..

TABLE 2.

Principal Outside Dimensions of a Few Large Roofed Cars.

NAME OF OWNER.	Weight-Carrying Capacity, Pounds.	Length over Sills.		Width over Eaves.		Height Rail to Eaves.	
		Ft.	In.	Ft.	In.	Ft.	In.
Chicago & Grand Trunk (Furniture................	60,000	40	4	9	7	12	2½
Chicago, Burlington & Quincy (Furniture).	50,000	40	..	9	9¼	12	6½
Chicago, Rock Island & Pacific (Furniture)........	50,000	40	11	9	9	12	9
Chesapeake & Ohio (Stock).........	60,000	..	..	10	..	11	4
Illinois Central (Furniture)............	60,000	45	7½	10	1⅝	12	11
Lehigh Valley (Poultry)......................	60,000	36	10½	9	9	12	1¼
Louisville & Nashville (Furniture).................	60,000	40	7⅝	9	9	12	2½
Minneapolis & St. Louis (Refrigerator)....	50,000	34	4½	9	11¼	12	..
Minneapolis & St. Louis (Furniture)......	60,000	41	..	9	9	12	6
Mansur & Tebbetts Implements Co................	40,000	60	5	10	..	13	5
Queen & Crescent (Ventilated)...........	60,000	34	11¾	9	9½	11	6
Union Line, Penna. Co. (Furniture).........	60,000	42	7½	9	5	12	4⅜
Wabash R. R. (Furniture).......	40,000	45	6	10	6	..	..

TABLE 3.*

A summary of the freight handled by a number of the most important roads (many roads do not give any classification of the freight handled by them), which we may accept as an approximate guide in consideration of the subject.

The total freight handled during 12 months, amounting to 152,658,240 tons, upon the following railroads, viz.:New York Central and Hudson River R.R.; Lake Shore R.R.; Pennsylvania R.R.; United R.R.'s of New Jersey; Philadelphia and Erie R.R.; New York, Lake Erie and Western R.R.; Atchison, Topeka and Santa Fé R.R.; St. Louis and San Francisco R.R.; Union Pacific R.R.,and 8,400 miles of railroads in Iowa, is classified as follows:

Coal and coke..............	66,289,094	tons	44	per cent	of total
Grain........	13,135,104	"	9	"	"
Lumber.............	11,588,910	"	7	"	"
Merchandise	20,427,453	"	13	"	"
Farm products	9,491,496	"	6	"	"
Animal products.	8,193,952	"	6	"	"
Petroleum..................	1,868,190	"	1	"	"
Ores........................	5,438,494	"	3.5	"	"
Pig and bar metal..........	4,905,372	"	3	"	"
Machinery and castings.....	3,385,395	"	2	"	"
Stone, etc.................	7,934,780	"	5.5	"	"
Totals	152,658,240		100	"	"

R. A. Parke, Westinghouse Air-Brake Co.

The customary practice of designing the brake gear on freight cars so that the maximum brake shoe pressure, as calculated from the brake cylinder pressure, shall be 70 per cent. of the light weight of the car, is based upon the demonstrated fact that a greater, uniformly-distributed brake shoe pressure will at times cause injurious wheel-sliding when the car is empty. Under the present conditions of air-brake service, therefore, 70 per cent. of the light weight of a freight car must be regarded as the maximum available braking force—or brake-shoe pressure for producing the retarding friction—under all the varying conditions of car service. Regardless of the light weight or the carrying capacity of the cars of a train, the most powerful effect of the air-brakes will occur when the cars are all empty and

*Extracted from the paper by Mr. Theodore Cooper, M. Am. Soc. C. E., upon the subject of "Train Loadings for Railroad Bridges," and printed in the transactions of the American Society of Civil Engineers for February, 1894.

The Committee calls attention to the fact that the only items of freight in this table which cannot be loaded up to, or beyond the weight capacity of the cars are merchandise. farm products and animal products. With such light, bulky freight, which constitutes about 25 per cent. of the total tonnage, the maximum carload is limited by the dimensions of the car body.

will then occur uniformly upon each. When the cars are more or less loaded, the effectiveness of the brakes, in stopping or controlling the speed of the train, becomes reduced as the ratio of the light weight to the loaded weight is decreased. When the cars are loaded to their maximum capacity, the effectiveness of the brakes obviously becomes a minimum. The ratio of the light weight to the fully loaded weight of freight cars thus becomes a matter of serious consideration, as influencing the effective control of freight trains by the air brake.

If each of the cars of a freight train weighs 25,000 pounds when empty and has a carrying capacity of 40,000 pounds, the maximum braking force, while 70 per cent. of the weight of the empty train, is but 27 per cent. of the weight of the train when fully loaded. The available brake resistance to the motion of the train is the same in both cases; but, when the train is fully loaded, there is 2 3-5ths times as much moving matter to be resisted as there is when the train is empty and the effective control of the train by the air-brakes is but 5-13ths, or 38½ per cent. as great.

If each of the cars of the train weighs 30,000 pounds when empty and has a carrying capacity of 60,000 pounds, the fully loaded weight of the train is now three times its empty weight and the effectiveness of the brakes, when the train is fully loaded, is but one-third, or 33 per cent. as great as when the train is empty.

It is true that, in general service, it is not the rule that trains are operated either without any paying load whatever, or with all the cars loaded to their full capacity. Some statistics from a trunk line indicate that, upon that road, the average paying load of all east bound freight trains is 62 per cent. of the total weight; wherefore, the light weight of trains is 38 per cent. of the average loaded weight. This average includes all the cars of different capacities. Still cars are often loaded beyond their rated capacity and trains are frequently made up of cars loaded throughout to their full capacity with grain, ore, coal or other special kinds of heavy freight and, without any doubt, the operation of such trains must be regarded as a practical condition of railroading which cannot be ignored. As above indicated, the ratio of the light weight to the fully loaded weight of freight cars has been reduced from about 38½ per cent. to about 33⅓ per cent. by the increase of the capacity of cars from 20 tons to 30 tons. It has been proposed to increase the carrying capacity of freight cars to fifty tons, or 100,000 pounds, by the introduction of a steel car, the light weight of which will still be maintained at about 30,000 pounds. The ratio of the empty weight to the fully loaded weight of such a car is but 3-13ths, or 23 per cent., and, with a maximum braking force of 70 per cent. of the light weight, the same braking force would amount to but 16 per cent. of the weight of the fully loaded car. If such a condition be compared with that of a fully loaded train of cars, each having a capacity of 20 tons, it is at once apparent that the train of such 50-ton cars could be controlled with only about 16-27ths, or less than 60 per cent. of the certainty and security that present air-brake service offers upon the fully loaded 20-ton cars heretofore in use.

E. A. Handy, Chief Engineer L. S. & M. S. Ry.

From a track maintenance point of view, the weight of cars should be kept down so that in no case will the weight on a given wheel-base exceed the weight on a similar wheel-base of the locomotives used on the road. In my judgment it would be better to keep the comparative car weight considerably below the locomotive weight. The damage to the track by a car which weighs as much on a given wheel-base as a locomotive would be very much greater ordinarily than that produced by the locomotive, for the reason that cars are much more liable to have flat wheels than locomotives, and are generally much harder on track in proportion to their weight than the average locomotive is.

E. C. Leavenworth, General Freight Agent G. R. & I. R. R.

There should be a maximum limit of size for large cars. Our standard box car to-day is of the following dimensions, inside measurement: length, 40 feet 1½ inches; width, 8 feet 6 inches; height, 8 feet, 7 inches. This we consider as a fair and reasonable size for boxcars, and it will permit us to handle many bulky articles at about the classification minimum weights, while the heavier articles can be loaded in these cars, giving us additional revenue as compared with the cars of ordinary size.

It has been suggested that the minimum weights should be advanced when cars of the larger capacity are loaded, taking a car 34 feet long as the basis for the classification. This I consider would be an injustice, realizing that for a number of years the present official classification has in substance been in effect throughout Trunk Line and Central Traffic Association territories. Either a 40-foot car should be taken as the basis for the classification, or the minimum weights in the classification could be reduced only for certain light and bulky articles, increasing the weights of all commodities loaded in large cars, using a certain percentage for each foot of increase in the length of cars. I will illustrate: The present minimum weight on furniture is 12,000 pounds. I would suggest that we make the weight 10,000 pounds, having in mind cars 34 feet in length. When cars of larger capacity are loaded, add 300 pounds for each foot of increase in the length of cars. When cars 40 feet in length are loaded on above basis, the minimum weight for furniture, if we use 300 pounds per foot, would be 11,800 pounds, or relatively the same as it is to-day. It is well understood that only the large cars are used for furniture and other articles of bulky freight, and roads throughout the country are gradually building the large cars, and many of them are beyond our standard limit cited above.

Paul Wadsworth, Assistant General Freight Agent D. & H. C. Co.

To reduce the entire equipment of our railroads to one standard, of say 50,000 or 60,000 pounds, would result in hauling a much larger percentage of dead weight for paying freight, than to employ a double standard of 30,000 and 60,000 capacity cars. The double standard would, in our judgment,

enable the carriers to provide equipment better adapted to the requirements of their customers and traffic, minimize the percentage of dead weight, and thus lessen the cost of conducting transportation in all of its various branches.

The maximum capacity of freight equipment is a question which not only involves the first cost of cars, maintenance, effect upon permanent way, bridges, and numerous other mechanical and transportation problems, but also an economic question, as viewed from a traffic standpoint; the convenience of loading and unloading, loss, by reason of damage, resulting from excessive weight of one package upon another, as for example bursting of flour, apples and similar freight in barrels.

In order to obtain the best results under a single standard, of say 50,000 to 60,000 pounds capacity, a readjustment of classification would be necessary, and this, we think, would result in scaling down the rates to induce shippers to increase their carload shipments, and it is a serious question, whether, after a few years, we should not find the revenue of our large cars about the same as that at present earned with cars of ordinary capacity, 30,000 to 40,000 pounds.

The comparative amount of paying freight to dead weight is, in itself, a simple problem, so simple that it should be lost sight of entirely in considering the more weighty matter, as to what is required to best meet the demands of the commerce of our railroads. This can only be determined by a careful analysis of the various classes of goods which we transport, with reference to their bulk, condition of packages, amount of shipment ment, etc., etc. To illustrate: if a customer wants 125 or 150 barrels of flour, we cannot induce him to take 200 barrels, in order that our cars may carry full loads; or, if an order for 10 yards of stone, or 50 squares of slate is received, we cannot induce the party to increase his order to 20 yards or 90 squares. In other words, the demands of the trade of our country regulate to a very large extent the quantity ordinarily shipped as a carload, and while we do not contend that this cannot be materially changed, we do maintain that it cannot be changed to a sufficient extent to warrant railroads, as a matter of economy, limiting their freight car equipment to a single standard as to capacity.

If a double standard is maintained, a single rule can be inserted in our classification, fixing a percentage basis of increase upon the present minimums where the large capacity cars are used, thus affording the carriers the proper amount of revenue for hauling such cars, and thereby eliminating much of the danger of reduced revenue, as referred to herein, and also avoid any complications arising from alterations in the classification of carload property, which, by the way, is one that might involve the carriers in a discussion of the entire question of classification with the Interstate Commerce Commission, a question which, in the past, has received much consideration from that body, and at present is not free from their earnest solicitation.

J. R. Cavanagh, Superintendent Car Service, Big Four System.

Situated as we are, one of the greatest originating lines in the country of shipments of bulky, low minimum commodities, the above question is one of great importance to us. We have hesitated for several years about building larger cars for the reason that any size we might decide on, some other lines would build larger ones, thus leaving us exactly where we were before we built the larger cars.

The only solution for the problem is for the roads to agree on maximum limits (length, width and height) for all classes of cars. Every time the sizes of cars are increased, the older or smaller ones depreciate. A uniform "standard" will obviate reckless and expensive competition and will certainly be of great economical benefit in maintenance, as well as in the distribution and movement.

It will be difficult to decide what these dimensions shall be. All things being considered, I would recommend the following:

Clear loading space:

Length, 36 feet.

Width, 9 feet.

Height, 8½ feet.

This will give the outside dimensions on box cars and stock cars:

Length over sills, 38 feet 4¾ inches.

Width over sills, 9 feet 8½ inches.

Top of rails to eaves, 11 feet 9½ inches.

It has been conceded that 36 feet is proper for stock cars, and many roads have also adopted this length as "standard" for box cars, and a few roads for all freight cars.

The following is the present Big Four "standard" for box and stock cars:

Length over sills, 38 feet 4¾ inches.

Width over sills, 8 feet 11½ inches.

Top of rail to eaves, 11 feet 9½ inches.

Capacity, 60,000 pounds.

The outside dimensions of our furniture cars are 39 feet 6 inches, length; 9 feet 3 inches, width; 12 feet 9 inches, height.

My proposed uniform "standard" exceeds in width by 9 inches our present "standard," and this is done to care for buggy and similar shipments. The figures as submitted, I think, come nearer being the minimum for handling an average load, after careful investigation of our list of commodities handled, and due regard for commercial standards of sizes, material, packages, etc. In many shipments of bulky freight, this car will hold more than some of the 40 foot furniture cars that are run over our line at present, on account of the 9 feet clear width.

Out of a total of 216 roads, there are only three or four lines on which these dimensions will not clear all obstructions, and they, being small, need not be taken into consideration.

The next thing to be considered is, "What shall we do with our small cars and those that exceed these dimensions?"

I think an adjustment of the minimums will regulate this by basing them on the cubic feet capacity of cars for the small equipment, and with the large cars in addition, fixing a penalty per foot above 36 feet in length that would soon drive them out. There is also plenty of local business that such cars could be assigned to and not work any great hardship, and have roads agree not to receive a freight car from connecting lines in excess of these dimensions.

From the latest Official Equipment Guide, there are owned by railroad companies cars in excess of 36 feet in length as follows:

37 feet	1,554
38 feet	2,021
39 feet	477
40 feet	7,134
41 feet	932
42 feet	335
44 feet	14
45 feet	115
46 feet	55
47 feet	5
48 feet	1
49 feet	10
Total	12,673

A. M. Waitt, General Master Car Builder L. S. & M. S. Ry.

I believe that, for the ordinary classes of cars, a limit should be set as to the length and capacity. It will always be necessary, to meet some special cases, to have certain classes of cars of extraordinary size and capacity. This, in most cases, will exist in cars which are used locally on the lines owning them. It would be very difficult for a standard to be adopted which would suit all companies, as regards the width and height of cars, especially the height. For some roads in the eastern part of the country are unfortunate enough to have low tunnels and bridges, which prevent the use of cars which are only of ordinary average height for other equally prominent lines. As a consequence, I think it will be difficult, if not impracticable, to set a limit in widths and heights that will satisfy all.

It might be well, and I think it would be of advantage, if a limit were set which would come within the requirements of the principal trunk lines of the country between New York and Chicago. I give these limits from the fact that roads west of Chicago are not hampered by bridges or tunnels, barring one or two exceptions. Roads east of New York are subjected to the limits of low bridges, which were constructed long before the day of 50,000 and 60,000 pound capacity cars. It would not be fair to railroads in general to limit the dimensions by either of these sections of the country.

As to the length of cars, I think as a matter of policy on the ground of safety in handling on curves and sufficient strength for long service, with

not above the average amount of depreciation, that a 40-foot car, either box, coal or flat, is as long as can be properly built to carry loads of 50,000 pounds or over. Of course there are special cars carrying light loads that can be safely built somewhat longer than this, although such cars are a source of danger in handling at anything but slow speed on cross-overs and on sharp or reversed curves.

The width of cars must be limited to a certain extent by the distance of the platforms and freight houses from the center of tracks; as this varies somewhat on different roads, it is difficult to set a limit that will suit all.

In regard to the capacity of cars, I question the wisdom of building cars for general interchange of over 60,000 pounds capacity, unless the car is constructed on an entirely different plan and of entirely different material from the combination of wood and iron now used. The heavier average loads that are put on cars means more rapid depreciation, severer shocks on the road bed, and as a rule a higher ratio of weight of cars to weight of load carried, and I question very much the economy in the long run of increasing cars beyond the quite generally adopted 60,000 pound capacity at the present time.

As I have said above in connection with dimensions of cars, it may be found wise for special lines of cars, run almost entirely on the line of the owning road, to run cars of higher capacity, the roads knowing that their road bed and the weights of freight received will warrant them in taking the risk of heavier cars and higher cost of maintenance.

Eventually I think steel will take the place of wood in the construction of the floor frame of railway cars to a great extent. When this day comes, it may be that cars can be constructed within reasonable limits of weight that will warrant increased capacity, without increased depreciation or too high ratio of dead load to paying load. Until such day comes, I should be glad to see a universal adoption of 60,000 pounds capacity as a limit for cars to be used in interchange in interstate commerce, and a limit in length of 40 feet over end sills.

R. Quayle, Supt. Motive Power and Machinery C. & N. W. Ry.

I find that the lines running west of Chicago show that the tonnage hauled per car varies from 9 to 12½ tons. This is taking an average of a year's work on the important lines. You can very readily see that if I were to base my opinion on the average tonnage hauled per car, I would at once conclude that the large car problem would be easily solved, and would at once say that the 40,000 pound cars are sufficiently large. Treating the subject in a general way there is no doubt but that the large car is the more profitable to a railroad company when it can be used in such service wherein it can be loaded nearly to its capacity. The average 30,000 pound box car will weigh about 20,000 pounds, and the average 60,000 pound box car will weigh about 30,000. Now, should we have 600 tons of freight to move, it would take forty (40) 30,000 pound cars or twenty (20) 60,000 pound cars to move it. The total weight of the 30,000 pound car train will

be 2,000,000 pounds and the weight of the 60,000 pound car train would be 1,890,000 pounds or a difference of 110,000 pounds in favor of the larger car, to say nothing about getting rid of half the wheelage, as well as half of the car surface that would be effected by atmospheric resistance. It is also a fact that the more nearly you have your load to your engine the more easily it is handled, so that where cars can be loaded to their capacity I am clearly of the opinion the larger car is the more profitable. There is one other fact in connection with this same thing. The train consisting of 30,000 pound cars would cost approximately $14,400. The cost of the 60,000 pound car train would be about $9,600, leaving a balance of $4,800 in favor of the larger cars, that could be placed into other equipment or left in the treasury for interest bearing. By using the larger cars the cost of repairs and inspection would be about one-half. On the other hand, when we consider that the average load does not exceed 10 tons, the figures would be reversed, and the lighter cars would be the more economical, as there is no use of hauling any more dead weight than is necessary to support the load.

From the standpoint of the earning power of a locomotive there is no question but that large cars properly filled is what we need. We have on western roads so many competitive points that we cannot hold cars for competitive points to get what we would call an average load, and are, therefore, compelled to send a car out in the evening time for its destination very frequently with only 2 or 3 tons of load, and these and many other things work against the successful loading of cars to their full capacity.

In ore business we have a large number of cars that carry 30 tons, and they are very much more profitable to us than are the 40,000 pound ore cars. We are now having new ore cars built of the large size. For coal and lumber such as gondola cars and flat cars, it would seem to me they ought to be built to carry not less than 70,000 pounds. It would increase the earning power of the road and the motive power department would show up to better advantage in the cost of freight hauled per mile. We have been agitating the subject of increasing the tonnage of the cars on this road the past year, and I think it will result in much good. I am also of the opinion that the freight cars to-day could be built lighter and the carrying power (strength) not decreased. When we consider that a great many roads in this country are only hauling ten (10) tons of load per car and the average weight of the car is about 14 tons, you can readily see that we are carrying four (4) tons more car than we are load, which certainly is a great loss, so that the writer is of the opinion that, were it practicable, it would be a good thing to have freight cars built for the different classes of service, and this problem cannot be successfully settled until we do one of two things, viz., either build different classes of cars for the different service, heavy cars for heavy service and light cars for light service, or hold cars until they can give them the maximum load.

E. Van Etten, General Superintendent N. Y. C. & H. R. R. R.

This matter is one that must be considered from all points, not only the

Transportation Department, but the Mechanical and Maintenance of Way as well. This being the case, we must not run to extremes in either direction. With the present maintenance of way and engine capacity, I believe we have reached the limit of tonnage when we build 60,000 pound capacity cars. If a new road were to be built from New York to Chicago, which would simply handle freight between those two points, transferring at either end, I can see where it would undoubtedly be economy to build larger freight cars, but this would necessitate better roadbed, heavier rail and larger engines, the standard of which should be equal to the capacity of the car.

The last freight cars built for this road were 35 feet in length over sills; 8 feet 10 inches wide; 11 feet 5¾ inches high at the eaves; 12 feet 4 inches at the running board, and 13 feet 4 inches at the top of the brake staff. These cars, with the Fox steel truck and other construction, weigh about 26,000 pounds, and have a capacity for a lading of 60,000 pounds, making in round figures 85,000 pounds total load, or about 22 tons on each pair of trucks.

Anything heavier than this will on most of the trunk lines now operated necessitate new bridges, heavier rails, better ties, heavier switching power, etc., which, in my opinion, is not warranted from an economical standpoint, nor is there any necessity for a car of larger capacity.

It may be possible that certain special cars can and should be built for the transportation of special kinds of freight, although as a rule I am opposed to this, believing that space should be charged for as well as weight.

F. D. Adams, General Master Car Builder Boston & Albany R. R.

Some time ago, when first the question of 60,000 pounds capacity cars began to be agitated, I took considerable pains to ascertain what the average tonnage was loaded from our station in Boston, and found it to be only about 8 tons to a car. I am fully convinced the majority of box cars are not loaded to their full capacity, while possibly many are overloaded. Perhaps this would not have much bearing on the question. There are certain kinds of freight without doubt that can be carried in large cars cheaper.

It will be very difficult to get a uniform style of construction or size of cars, unless a positive law were passed to make cars alike. If you establish a uniform kind of construction, you obstruct all improvement.

J. T. Wallace, Chief Engineer Illinois Central.

The size and weights of cars should be determined by the question of economy from a transportation standpoint. If our transportation and traffic officers have settled that large units of transportation are necessary in order to economically move freight, and reduce the cost per ton per mile of freight moved, then it devolves upon the engineering and roadway departments to adapt their structures to the condition of things. Should, however, the size of cars reach such a stage of development as would render

it necessary to radically change the track spacing, head room in tunnels, bridges, etc., the question would assume another phase which would simply be, whether the reduced cost of transportation was sufficient to warrant the expense occasioned by the necessary radical changes in structures and track. Until that time arrives the question will not assume great importance from a roadway department point of view. As far as the increased weights are concerned, the structures and roadbed can be economically kept up on a majority of our railroads to meet requirements.

R. P. C. Sanderson, Division Supt. Motive Power Norfolk & Western.

I believe that the railroads of this country should adopt standard sizes and lengths of box and stock cars for 50,000 and 60,000 pounds capacity only, and that larger or smaller capacity cars than these should not be built for general interchange business. The lengths for these cars should be 34 and 36 feet over the bodies. I see no reason why, with steel framing, cars of 70,000 and 80,000 pounds capacity should not be built for carrying coal, coke and minerals, but I do not think that considering the small average loads now carried by the present 60,000 pounds capacity box, that it would pay to increase the carrying capacity of the box car and stock car over 60,000 pounds, and think that the managements, after an agreement has been come to by the representatives, should pledge themselves to stick to these figures. The fewer different sizes of cars there are in general interchange business, the less expensive and troublesome the yard management will be. The more special shifting has to be done to get cars of certain sizes placed and drilled out for loading and unloading, the greater amount of money will have to be invested in yards and sidings, and the greater the amount of expenses in yard management and shifting crews, which expenditures I believe will more than offset any slight gain in advertising the railroads may be able to make by having jumbos to offer for certain shipments under the present system of making carload rates.

J. B. Moll, General Road Master C., M. & St. P. Ry.

It would seem to me from the standpoint of track maintenance on the road I am connected with, that we have felt but little ill effects from the heavier cars, as in the past eight or ten years we have been gradually working into a much heavier rail section, larger and more ties per mile, and better and more ballast. Greater care has been taken in every direction to keep our track up as nearly perfect as could be done with the amount of help which we were permitted to have; and I must say that at the present time our track is in much better condition than what it was in former years, with a very largely increased business and a large number of 60,000 pounds capacity cars as well as sixty-ton locomotives. Of course our bridges were strengthened to conform to this kind of traffic. It would seem to me, however, that with the present speed that we are making with all kinds of trains, that the maximum weight of cars and engines has probably pretty

nearly been reached for the economical operation of roadway as well as traffic.

A. E. Mitchell, Superintendent Motive Power N. Y., L. E. & W. R. R.

I will present one side of the problem, and endeavor to show how an increase in the length and capacity of box cars may increase the earnings and reduce the operating expenses, so far as the transportation side of the problem is concerned, but when the additional cost of maintenace of way, etc., is considered, the results may be entirely different.

In my judgment no conclusions can be drawn from this treatment of the subject alone; similar arguments should be brought out on all other phases of the subject and from them all conclusions may be drawn.

The first question which must be considered is that of capacity, i. e., shall we increase our carrying capacity over 60,000 pounds, the greatest capacity of box cars now in general service?

As the increase in the capacity of box cars in the past has been gradual, and by increments of 10,000 pounds, it may be assumed that if any increase in capacity is generally adopted, the capacity of such cars will first be 70,000 pounds and be capable of carrying the used excess load of 4,000 pounds, and after this capacity of car has been in service a few years the 80,000 pounds capacity car capable of carrying the usual excess load of 4,000 pounds may be built; hence on this phase of the question I will only consider the 60,000 pounds and 80,000 pounds capacity box cars.

The present 60,000 pounds capacity 34 feet box cars, when loaded with wheat, will have its lading about 5 feet 2 inches deep, and with the same cross section and depth of lading an 80,000 pounds capacity box car must have a length about 45 feet, but with a longer car, the height would probably be slightly increased, hence we will consider our 80,000 pounds capacity car 38 feet long and its depth of lading 5 feet 8 inches. This car would then be of about the following dimensions:

Inside width, 8 feet 4 inches.
Outside width over sheathing, 9 feet 2 inches.
Inside height under carline, 7 feet 5 inches.
Length over end sills, 38 feet.
Height, top of rail to eaves, 12 feet 2 inches.
Height, top of rail to top of running board, 13 feet.
The 60,000 pounds capacity car being of the following dimensions:
Inside width, 7 feet 11 inches.
Outside width over sheathing, 8 feet 9 inches.
Inside height under carline, 6 feet 11½ inches.
Length over end sills, 34 feet.
Height, top of rail to eaves, 11 feet 8½ inches.
Height, top of rail to top of running board, 12 feet 4½ inches.

You will, therefore, note that a car cpable of carrying 80,000 pounds load is but very little larger than the 60,000 pounds capacity car, and it is safe to

say that many roads are building box cars of greater dimensions than the one given.

By the use of the longer and greater capacity car a material loss will result unless the average tonnage per car per mile is correspondingly increased, as the extra weight of the car will increase the dead load and the extra length will needlessly lengthen the train. Again, increased storage and switching tracks would be required with the longer and greater capacity cars for the same number of cars. The longer and greater capacity car would cost somewhat more to build and possibly will cost slightly more to maintain than the shorter car.

It is obvious, therefore, that if a longer and greater capacity car is to be substituted for our shorter and lighter 60,000 pounds capacity cars, an increased average tonnage per car must be obtained to effect a saving and increase the net earnings per car load. On nearly all roads the majority of the tonnage is in one direction and cars must necessarily move in the opposite direction either empty or with a comparatively light load. If we increase the average tonnage per car in the direction of the loaded traffic, we certainly will decrease the movement of empty cars in the opposite direction. The question, therefore, resolves itself into which is the most economical car to use, the 60,000 pounds or the 80,000 pounds capacity, the cost of maintenance to be considered—grain and agricultural products to determine the length of the car.

Experience has taught us that our modern 60,000 pounds capacity box cars, designed carefully for strength, well and solidly built, cost us no more to maintain than the cheaper built and weaker designed 30,000 pounds, 40,000 pounds and 50,000 pounds capacity cars now running on all the trunk lines, and it may be safely assumed that if 80,000 pounds capacity cars are well and thoroughly built of good material from careful designs, the cost of maintenance over our present 60,000 pounds capacity box cars would not be very materially increased and probably would be more than offset by the average increased earnings from the extra load carried per car in the direction of the light traffic, and the reduction of dead weight per ton of paying freight would be considerable.

The economical effect of lessening the dead weight and increasing the capacity may be illustrated by taking the problem of moving monthly over a division 100 miles in length, one million net tons of wheat with locomotives capable of pulling a dead load, including engine, cars and lading, of 2,100 net tons, or slightly more, over the controlling grades, and moving in the opposite direction one hundred thousand net tons of general freight.

A 60,000 pounds capacity 34-foot box car weighs about 30,000 pounds, and an 80,000 pounds capacity 38-foot box car will weigh, say, 34,000 pounds, and the locomotive with coal, water, etc., we will assume will weigh 100 net tons—using these figures our results are shown on accompanying table No. 1.

The report of the Interstate Commerce Commission for the year 1890 shows that the average cost of carrying freight on all the railroads of this

country is .604 of a cent per ton per mile and the average revenue .941 of a cent per ton per mile—the factors upon which the average cost is based being the total operating expenses chargeable to freight traffic and the ton mileage.

If it costs .604 cents per ton per mile for hauling freight and the total weight of the train is 2,095 tons, 33.2 per cent. of that cost is chargeable to dead weight and only 66.8 per cent. to paying freight. Therefore, in our problem the cost of handling the dead weight of 35 cars of 80,000 pounds capacity, and the locomotive, is .201 of a cent per ton per mile and the cost of hauling the paying freight is only .403 of a cent per ton per mile.

Our table, No. 1 (on page 32), gives figures which are misleading, as they are based on the locomotive being loaded to its full tractive power in both directions, but it is self-evident that if there are required 715 trains to handle the grain lading east bound, there certainly must be an equal number of trains west bound, or else some of the power must return over the division light in order to get where it is needed. Considering this phase of the subject, the figures will be notified as per table 2. From this second table it can be readily seen that with the 80,000 pounds capacity cars 35 cars will carry 1,400 tons of wheat, whereas, with the 60,000 pounds capacity cars 44 cars can only carry 1,320 tons, the weight of the train and its lading in both cases being practically the same, 2,095 and 2,080 tons, respectively. With a train of 80,000 pounds capacity cars we have to maintain 36 less axles (if 4-wheel trucks are used), 72 less wheels, 72 less journal boxes, 72 less brasses, 36 less brake beams and 18 less M. C. B. couplers and draft riggings, to say nothing about the maintenance of 9 less car bodies, and if we consider the total cars required for this service, or only the daily car movement of 1,666 as against 2,222, an estimate of the large saving which can be effected by the substitution of larger capacity cars can be readily made.

The table also demonstates that the increased net revenue per car mile run in the direction of the heavy traffic will be 4.6 cents, provided the cars are loaded to their marked capacity and when cars are only loaded to an average tonnage of 7 tons on the return trip a greater loss would result to the company in being obliged to have 571 pounds more dead weight per net ton of paying freight, unless we consider the fact that if 7 tons weight is the average lading of 60,000 pounds capacity box cars at present, a reduction of the car movement east of about 8 per cent. (7.93), if the 80,000 pounds capacity car were substituted in their place (the heavy tonnage governing the number of cars required in the service) would result in a saving, as the average load in each car in the direction of the light movement would be increased to 8.8 tons, and the dead weight per net ton of paying freight would be 3,863 pounds, with the 80,000 pounds capacity car, instead of 4,285 pounds, as would be the case with the 60,000 pound cars. Similar arguments can be used to show the advantage of using cars of still greater capacity than 80,000 pounds, hence the weakness of this argument in deciding on the length and capacity of cars.

The subject is of such magnitude, I know of no better way to solve it

than by asking questions and let each department of the railroads answer them.

Query 1. Considering that a locomotive is an engine of destruction to the roadway and bridges, can we consider that each car behind such locomotive is an engine of destruction of equal magnitude, provided the weight of the car per running foot is the same as that of the locomotive?

Query 2. Can the weight per running foot of cars in the train equal to or exceed that of the locomotive without excess damage to track. If the weight can be in excess of that of the locomotive, how much excess would be proper?

Query 3. What maximum weight per running foot of the locomotive should be permitted on the various weights of rails?

Query 4. What speeds should govern such maximum weights per running foot?

Query 5. Provided each car weighed per running foot the same as the locomotive, would a train of 49 cars and locomotive damage the roadway twice as much as one train of 24 cars and locomotive?

Query 6. How much extra will it cost to maintain each additional foot in length of a car, the same general design to be followed as of the car 34 feet long, the capacity in each case to remain the same.

Query 7. How much more will it cost to maintain a car of a given length of 80,000 pounds capacity than one of 60,000 pounds capacity—the general style of construction to be the same?

TABLE 1. (A. E. Mitchell.)

		East.	West.	East.	West.
Cars in maximum train		35	95	44	109
Capacity of cars, lbs.		80,000	80,000	60,000	60,000
Average lading in each car, net tons		40	4	30	3⅓
Light weight of car, net tons		17	17	15	15
Total weight of engines, cars and lading, net tons.		2,095	2,095	2,080	2,098
Dead weight of engines and cars per train	Net tons	695	1 715	760	1,735
	Percentage.	33 2	81.88	36.54	82.7
Paying freight per train	Net tons	1,400	380	1,320	3,633
	Percentage.	66.8	18.14	63.46	17.3
Cost of haulage of 100 miles based on .604 of a cent per ton per mile	Dead weight	$139 37	$847 96	$167 73	$866 65
	Paying freight.	564 90	41 63	505 96	37 97
	Total.	704 27	889 59	673 69	904 62
Revenue per 100 miles at average of .941 of a cent per ton mile	Gross earnings per train.	1,317 40	357 58	1,242 12	341 90
	Net revenue per train	613 13	Loss. 523 01	568 43	Loss. 562 72
Net revenue per car		17 52	Loss. 5 6c	12 92	Loss. 5 16
Number of trains to move freight		715	264	758	306
Dead weight per net tons of capacity, lbs.		850		1,000	
Total net revenue for moving specified freight		$437,950	Loss. $140,000	$430.675	Loss. $172,087
Net revenue for round trips		$297.950 00		$258.588 00	
Average revenue per car per round trip		11 9?		7 76	
Total car loads, East bound		25,000		33.334	
Average car movement East per day		833		1,111	
Average trains per day East.		24		26	

TABLE 2. (A. E. Mitchell.)

	East.	West.	East.	West.
Cars per train	33	33	44	44
Capacity of cars, lbs	80.000	80,000	60,000	60,000
Average lading in each car, net tons	40	4	30	3⅓
Light weight of cars, net tons	17	17	15	15
Total weight of engines, cars and lading, net tons	2,095	835	2,080	907
Dead weight of engines and cars per train — Net tons	695	695	760	760
Dead weight of engines and cars per train — Percentage	33.2	83.23	36.54	83.79
Paying freight per train — Net tons	1,400	140	1,320	1,467
Paying freight per train — Percentage	66 8	16.67	63.46	16.21
Cost of haulage of 100 miles based on .604 of a cent per ton per mile — Dead weight	$139 37	$349 38	$167 73	$384 63
Cost of haulage … — Paying freight	564 90	14 18	505 96	14 36
Cost of haulage … — Total	704 27	363 56	673 69	398 99
Revenue per 100 miles at average of .941 of a cent per ton per mile — Gross earnings per train	1,317 40	131 74	1,242 12	138 02
Revenue per 100 miles … — Net revenue per train	613 13	Loss. 231 88	568 43	Loss. 260 97
Net revenue per car	17 52	Loss. 6 62	12 92	Loss. 5 93
Number of trains to move the freight	715	715	758	758
Dead weight per net tons of lading, lbs	850	9,930	1,000	10,634
Total net revenue for moving specified freight	$437,950	Loss. $165,751	$430,675	Loss. $197,815
Net revenue for round trips	$272.699 00		$232,860 00	
Average revenue per car per round trip	10 90		6 99	
Total car loads	25,000	25,000	33,334	33,334
Average car movement per day	833	833	1,111	1,111
Average trains per day	24	24	26	26

B. B. Mitchell, General Freight Agent Mich. Central R.R.

The recent action of the Official Classification Committee in readjusting the minimum carload weights so as to in part remedy the situation, will no doubt do much to assist in the fairer distribution of cars; but the change is hardly radical enough. The only solution of the problem that I can suggest, and which I very much favor, is to make a classification providing for rates in cents per 100 pounds regardless of the quantity, abolishing the carload rating, except on the very heavy freights that can be loaded to 30,000 pounds in a small car.

J. T. Chamberlain, Master Car Builder B. & M. R.R.

For regular service, I think that a 60,000 pound capacity car is sufficiently large to meet present requirements, and in saying this I realize that in special cases where cars are bound to and from certain points where they will receive loads of 80,000 pounds and upwards, a larger car is required. But I do not believe that it is practicable at present, at least for roads such as I am connected with, to build cars to carry over 60,000 pounds; and to build cars whose journals measure 4¼x8 inches, the rest of the car would have to be strengthened in the same proportion as the axle was strengthened from 3¾ x 7 inches to 4¼ x 8 inches.

I once had occasion to look into the figures of a large line having a heavy

western connection, and found that the average tonnage in all classes of cars running out of Boston was about seven tons.

Herbert Wallis, Mechanical Superintendent G. T. Ry. of Canada.

As far back as the year 1873, when the gauge of the Grand Trunk Railway was changed from 5 feet 6 inches to 4 feet 8½ inches, it was the generally accepted rule that a box car weighing 10 tons had a carrying capacity of the same weight. At that time engines having cylinders 17 inches in diameter were looked upon as being of average size for ordinary railways.

During the years intervening an era of cheap transportation, induced by excessive competition, which has reduced the average receipts per ton carried to probably one-third, has brought about a change in the character of the locomotives and cars.

The original 10-ton car has been gradually strengthened by the addition of body and truck truss rods and heavier springs, axles and wheels, for carrying capacities, following respectively, of 12, 15 and 20 tons, until we have attained to a standard box car weighing 13½ tons and carrying 30 tons, while locomotives (size of cylinder and higher steam pressure taken into consideration) are built for hauling gross train loads 50 to 60 per cent. heavier.

Looking back over the past 20 years I have noted upon the railway with which I am connected an increase in the average gross tonnage per freight train of nearly 30 per cent., due to the enlarged capacity of the engines, while the proportion of paying or net freight composing the same has increased by 50 per cent., due to the enlarged capacity of the cars.

It is, of course, true, all other conditions being equal, that an increase in the weight per train involves an increased cost of working the same, but the comparative ratio is much less; and, as a matter of fact, working expenses per train mile have fallen during the period mentioned to the extent of 30 per cent., which is no doubt mainly due to the cheapening of fuel, stores and other materials used in railway operations, effected by the transportation in larger and better distributed train loads.

Similarly it may be said that the ratio of increase of the dead weight of cars bears only a small proportion to the increased carrying capacity, of course assuming car lengths to remain as they are now.

Dealing with the figures I have given, it will be seen that an increased dead weight of 35 per cent. has made possible an increased carrying capacity of 200 per cent.

I think that we cannot expect to limit the carrying capacity of freight cars by anything short of their actual cubical contents, but I doubt the advisability of increasing it if that course should involve an increase of length.

The railway which can produce the most economical results is, other things equal, the one whose locomotives can haul the largest tonnage of paying freight per train.

I refer in these remarks, of course, to the trunk lines, on which the supply of east bound freight is such that it can be hauled in full train loads.

Small capacity cars will always be useful for local freight and freight of a special character.

The key to the position is, in my opinion, the length of the car, and I think that we have reached the limit in 34 feet.

J. N. Barr, Superintendent Motive Power C., M. & St. P. Ry.

I am very decidedly of the opinion that the tendency to build large cars is bad from every point of view, and I believe nearly all railroad men concur in this opinion. I have given the matter considerable thought, and have discussed it quite a good deal, both with traffic and operating men, and I am inclined to think that the Traffic Department holds the key to the situation. If their rates were not of such a character as to encourage and almost compel the construction of unduly large cars we would not have any difficulty of this kind.

W. G. Curtiss, Assistant to General Manager Southern Pacific.

In general, everything accomplished in the direction of increasing the average lading of freight cars, and the average number of tons of paying load hauled by each locomotive employed in freight service results in substantial reductions in the cost of conducting transportation. It is not easy to meet all of the varying conditions of freight service with cars of any particular standard size, or weight carrying capacity. To illustrate, I am familiar with a continuous line of railroad 2,500 miles long, transporting regularly miscellaneous freight for the entire distance. This through line is, for the most part, equipped with box cars 34 feet long, 8 feet 2 inches wide and 7 feet high, inside dimensions; weight empty, 27,000 pounds; load capacity, 60,000 pounds. With the bulk capacity fully utilized, the average lading of these cars with miscellaneous merchandise is a little less than 30,000 pounds—one-half of the weight carrying capacity.

There has been used experimentally in this line, some large box cars, set low upon the trucks with draft rigging between the center sills, and of the following dimensions: Height from top of rail to top of car floor, 3 feet 5 inches; length, 40 feet; width, 8 feet 8 inches, and height, 9 feet, inside dimensions; weight empty, 30,000 pounds; load capacity, 60,000 pounds. Experiments with these cars, which have been run for nearly two years over steep gradients and road having much curvature, a great deal of it to the maximum of 10 degree curves, indicates that equipment of these dimensions can be run as safely as cars of ordinary dimensions, and by their use the dead weight in each train is considerably reduced, and the live, or paying load, correspondingly increased.

Now, while these large cars are undoubtedly economical for the conditions stated, their use would not be advisable under other conditions. For example, take the case of a city (with which I am familiar) of 80,000 people, having a number of short railroad lines ranging in length from 25 to 100 miles, radiating from it. Here competition and other conditions require a prompt freight service, and for the more important of the outlying towns

a car must be loaded out from the city every day; and the experience obtained from this situation leaves no doubt of the fact that a car 24 to 28 feet long, with ten tons carrying capacity, is the most economical car, inasmuch as the use of such cars tends to show the minimum of dead load and the maximum of paying weight in each train.

I have not considered the use of larger cars than the 40-foot box car above described. Where such cars can be used to produce economies in the cost of conducting transportation, no objections to their use has been developed in our experience with them, either from the view point of the transportation, the mechanical or the maintenance of way officers.

As to the standardizing of parts of cars, much good work has been accomplished by the Master Car Builders' Association, and much remains to be done by them. The early builders of cars, in the light of present knowledge, began wrong in so many things that, in the natural order of events, it will take a long time to get everything right. I look for the time when the Master Car Builders' Association will help the railroads to effect considerable economy in the maintenance of draft rigging by discarding the clumsy and unmechanical draft timbers altogether and putting some good form of continuous draft rigging where it properly belongs— between the center sills of the car, making the draft rigging attachments, as they properly should be, the strongest parts of the car.

Were I to propose a general rule for correcting the weak parts of freight cars and consequently reducing the cost of repairs to the minimum, I should say that, where anything is continually breaking and wearing out, pains should be taken to discover the weak places, and thereafter efforts should be made to make these places the strongest points about the cars.

The natural tendency of the freight car designer, in common with designers in many other branches of industry, is to make their construction of too many pieces, frequently, as in the case of some forms of spring planks in trucks, using 12 or more pieces where one piece of channel bar of the same weight will serve the service better.

Another example: Take the sill steps on a car, where frequently both ends of sill steps are attached with lag screw (when bolts should always be used to attach to the car everything affecting the safety of the employees), one of these fastenings being on the underside of the side sill and alongside of a framing bolt. Obviously, one end of the sill step will displace a washer and the sill step will be held up by this bolt better than by an independent attachment.

Again, we frequently see dummy coupling hooks for the air-brake hose attached to the underside of the draft timbers by special lag screws, when the end of the hook can be slipped over the lower ends of two hold-up bolts, displacing two washers and making a much better job, with the substantial advantage that all of the work done in keeping these bolts tight keeps the dummy coupling hooks in position.

In connection with the Master Car Builders' type of couplers, we almost invariably see a special bearing for the uncoupling lever on top of the buffer

block, where, on the ordinary forms of this block, there is a vertical bolt holding up the drawbar carry-iron, this bolt having a washer; and here we have the opportunity of making a combined washer and unlocking lever bearing, and again the labor of keeping this bolt tight takes care of the bearing in question.

Another example: We often find freight car buffer blocks used as bearings for the center body truss rods, the nuts of these rods having special washers interposed between them and the face of the block, while the same buffer block carries a buffer plate attached more or less loosely with lag screws. Obviously, with a buffer plate made of the proper form, it will better serve its definite purpose, make a better bearing for the truss rods nuts, be held more securely in position and the labor of keeping the truss rods nuts tightened takes care of the plate automatically, so to speak.

I mention these examples to indicate that many of the details of freight cars can be modified, reducing the number of parts and improving the construction.

Theo. N. Ely, Chief of Motive Power Penna. R.R.

The most important phase of the subject seems to be that which treats of the relation of the size, or capacity, of freight cars to the rates charged for carrying traffic; that is, the establishment of a rate unit, independent of the size of the car.

I hardly think it practicable to adopt a universal standard of construction or capacity. Each railroad company has problems peculiar to itself to be worked out, and it can only ascertain by the most careful and intelligent watching what classes of cars it can operate to the best advantage, taking into consideartion its physical cond tion and commercial requirements.

John Mackenzie, Supt. of Motive Power N. Y., C. & St. L. R.R.

The standardizing of the parts of cars would be of inestimable value to the railroad companies, and I believe that part of the committee's work is one that will return large profits, if adopted even in a small way.

The larger cars cannot be maintained, from a mechanical standpoint, as cheaply as those of smaller size, and this is largely due to the excess tonnage when under load. Many of the box cars built to-day of 60,000 pounds capacity will, when under load, represent 100,000 pounds on four pairs of wheels.

In regard to coal cars, there is no reason why a capacity of 30 tons is not an economical load, and a car capable of handling 30 tons can be built so that the dead load will not exceed 11 tons. Many of the cars of to-day of 60,000 pounds capacity run up to 34,000 pounds light weight.

He also thinks that two types of cars could be advantageously designed and used: one for heavy lading and the other for light merchandise.

J. J. McVean, Chief Engineer D., L. & N. System

The principal difficulty from an engineer's standpoint of increasing the capacity and weight of cars is that we do not know what the maximum will

be, in order to provide for safely carrying the cars, and increased weight of locomotives necessary to haul them in proportioning bridges and track.

The bridges which were built 15 years ago ought to be, if the loads have not been increased, perfectly safe at the present day, but in my own experience, I have had to take out two or three iron bridges which were designed at that time, because they were overstrained by the increased loading of trains, and replace them with bridges of a strength to correspond with "Cooper's Class A, Heavy," which it seemed would be heavy enough to carry all the loads that would be liable to reach them. This, however, has now been exceeded, and we are building our bridges to carry loads corresponding to "Cooper's Class A, Extra Heavy," and I fear this will soon be exceeded, if the mania for large cars increases.

When cars of 20,000 pounds capacity were used, the rail upon which they were to travel, was thought necessary to be, at least, 60 pounds to the yard, and many miles of that weight of rails are still in our tracks, some have increased to 65, a few to 70, and but very few above that. The capacity of the cars has more than trebled, besides the weights of the cars have so largely increased, while the wheel base of the truck carrying them has not been increased to any appreciable extent, and the extra weight is concentrated at points about the same as it was with the smaller weights. This makes it, of course, more destructive to rails and short span bridges, than it would have been could it have been distributed on the large wheel base. The managers, as a rule, say nothing against the increased capacity and weight of cars, but object strenuously to any increased cost per mile of steel rails or per foot of bridges.

It is hard to tell what the maximum allowable capacity of cars should be, but there must be a place where the destruction of roadbed and the extra cost of maintaining a roadbed by reason of these heavy loads will exceed the economy of increasing the load per car. This has begun to be felt throughout the country very seriously, as it is getting to be very expensive keeping and maintaining a roadbed in first class condition. The ties are destroyed in a very short time, which makes the cost of maintenance very much greater than it was a few years ago; and at the present time with 65 pound rail on wooden ties, it is found that the ties last but a short time and the plates are being used quite extensivly to try and counteract this excessive wear; besides, the rail itself is being rapidly destroyed, not by wear, but by bending.

G. W. Rhodes, Superintendent Motive Power C., B. & Q. R.R.

If the railroad makes a minimum load that will not go into ordinary railroad company cars, it certainly is offering a premium to some one to build a car which will carry the minimum load. If railroads pay the same mileage for hauling a big car that they do for hauling a small car (in some cases, refrigerator cars, the heavier the car is the greater the rate for mileage), and if they keep up all the principal repairs, as is generally done at the present time, it must be obvious that the greatest possible inducement is being offered to construct large cars. If the following rules were enforced it would aid much towards discouraging the building of large cars:

1st. The minimum load must never be greater than the carrying capacity of the car.

2d. All repairs to cars except those occurring in wrecks should be paid for by the car owner. Large cars cost more and are not constructed as strongly as small cars, and they are consequently much more expensive to maintain.

3d. The mileage allowances for cars should not be as great for long, heavy cars as it is for light cars. It costs a given figure per ton to haul tonnage, and will cost this figure whether the tonnage is in freight or in dead weight of big cars.

We are of the opinion that the present attempt that is being made to limit the construction of large cars will prove of no avail until it is made unprofitable for anyone to build them, which can only be when they are less profitable to own than smaller cars.

A. C. Bird, General Traffic Manager C., M. & St. P. R.R.

I believe that the problem of large cars has arisen because traffic officers have not kept sufficiently in touch with the transportation feature of the question, and the necessity for a reduction in the cost of operation, which the constant downward tendency of rates makes imperative. There is hardly room for doubt that the net profits which go to the stockholders are nothing more than the aggregate of minute economies that result from modern improvements. If this is not wholly so to-day, it will be in the near future.

To increase the carrying capacity of freight cars without an equal increase of the dead weight, reduces the cost of transportation. Improvements in this direction have probably kept pace with the improvements in track and motive power, and it is reasonable to expect further economies in this direction.

A few years ago a car weighing twenty thousand pounds carried a maximum load of forty thousand pounds, or two hundred per cent. of the dead weight of the car. To-day a modern car weighing twenty-four thousand pounds or less, will carry sixty thousand pounds of paying freight, or two hundred and fifty per cent. of the dead weight of the car. The freight car equipment of the country may be said to be in a transitional state. A large proportion of the older cars now in use are of much smaller dimensions and capacity than those of modern construction, and the large cars of to-day will probably be the small cars of the future.

We cannot reasonably expect the time to come in our day when all cars will be of the same dimensions and capacity. The problem seems to be, how can the carriers avail themselves of the benefits which may be derived from the improved construction of road, motive power and cars? or how can we best utilize the present equipment of varied dimensions and capacity?

I see but one solution of this question. That is, to arrange classification and rates so that a small car will be as desirable to the shipper as a large car.

Thirty years ago, a carload of ordinary freight was carried for so much

per car regardless of the actual weight. In later days the principle of charging so much per 100 pounds actual weight was established. In still later times the practice of applying carload rates based upon minimum weights has been established and enlarged upon. This practice is injurious in all cases where the property carried is of such bulky nature as to prevent the loading of the prescribed minimum weight in ordinary cars, and it has resulted in a loss which is doubtless equal to all that has been gained by improved construction. It has given impetus to the construction of cars by private individuals to accommodate their particular business, and such private cars are used and mileage paid thereon, when the carriers' own cars were standing idle. It has made it necessary for the operating department to build cars of extraordinary cubic measurements and haul them long distances empty for some particular shipment, when the side tracks at the shipping point were full of idle cars which had been discounted by an unwise classification.

It has created unjust discriminations between individuals and communities that would not be tolerated, were the facts and effects fully realized. A shipper of bulky freight cannot know what rate he must pay per hundred pounds or per package until he gets his car. Until all cars are of the same dimensions, a carrier cannot serve all shippers or communities under present methods.

A manufacturer gets a large car to-day and a smaller car to-morrow. An uncertainty prevents him from conducting his business with precision. In some instances where bulky freight is involved, the actual rate (per hundred pounds) charged for a small car is one hundred per cent. greater than that which is charged for a larger one.

It seems to me that the only available remedy is a reconstruction of the classification. An article which cannot be loaded in an ordinary car to a reasonable minimum ought not to be given a carload rate.

My conclusion is, that our troubles arise principally from the fact that reduced rates have been conceded from time to time on bulky freight upon the condition that twenty thousand pounds should be charged for, although it was known that that quantity could not be loaded into an ordinary car. Such concessions would not have an injurious effect if cars were all of the same dimensions, but the progress made by the operating department in the construction of new cars has been neutralized by the very natural demand of shippers that they be furnished with large cars, and so far as this particular class of business is concerned, modern cars of large dimensions have displaced all ordinary cars and made them practically useless.

J. F. Goddard, Commissioner, Trunk Line Association.

As an operating question only, my experience has taught that from a standpoint of economy, including first cost, maintenance, percentage of dead to total weight moved, the best results are secured from freight equipment not exceeding thirty-three feet in length over all.

From a traffic standpoint, the question of the dimension of freight cars is

a more complicated one, particularly as to box car equipment, as there is no fixed length, height or width that suits all kinds of light or bulky freight as now put up. This condition is doubtless largely the result of the lack of an agreed standard between the railroad companies, followed by a similar lack of uniform packages put up by shippers and coupled with the unreasonable demand by shippers, too frequently conceded by the railroads, that cars should be built to fit their packages instead of the reverse, which should be and will be the case when the railroads will arrange for uniformity in this regard.

From a traffic standpoint, the question of the height and width of cars is as important as that of their length. Fortunately, these dimensions have been somewhat limited by tunnels, bridges, etc. So far as I observe, shippers are no better satisfied to-day than they were when 28 feet was the maximum length, nor will they, in my judgment, be satisfied until some standard of maximum measurements is reached. The desirability of reaching such an agreement is, considered from every point of view, beyond question.

In regard to the use of small cars now on hand, the question, so far as the public is concerned, is mainly as to their employment in loading light and bulky freight. The most equitable way to overcome this difficulty now appears to me to be the adoption in our freight classification of a graduated scale of minimum carload weights on the cubic capacity of the cars.

This would require, as a practical measure, that the cubic capacity be stencilled on all cars. I am not unmindful also of some, at least, of the arguments which can be brought against such a plan, but all things considered, I believe it is practicable and the most equitable plan to both the public and the railroads that has so far been suggested.

Whether the plan suggested of a graduated scale of minimum carload weights based upon the cubic capacity of cars should be made to apply to other than box cars; it does not occur to me that it would be necessary to do so.

While it is undoubtedly true that the most economical limitations of dimensions and capacity of cars might vary, in the event of the general adoption of different material from that now generally in use, I am not clear but what it would be wise to recommend limitations based upon the present use of materials, coupling with it the statement that in case iron or steel should enter more largely into the construction of cars, these limitations might be changed.

I make this suggestion, feeling that it will be some time before any very marked change in the material used in the construction of cars will occur, and in the meantime new equipment is being constantly built upon former plans, which equipment will doubtless be in use for many years to come.

In regard to the proportion of light and bulky freight to the total traffic moved, I am not aware that there are any general statistics on this subject. It is an important factor, and yet it is doubtless true that these proportions vary very largely with different roads and in different sections of the country.

As an illustration of the extremes of this variation, it occurs to me that perhaps the Grand Rapids & Indiana Company might show a maximum percentage of light and bulky freight, while a minimum percentage of such freight would quite likely occur with roads like the Pennsylvania.

David L. Barnes, Consulting Engineer.

In taking up work for several car companies I have individually reached the following conclusions:

First. No M. C. B. standard of details of the woodwork of cars will ever be agreed upon.

Second. When steel under-frames are introduced the difficulty of obtaining material for construction and repairs will compel the use of standard shapes and lengths of rolled sections. This has been the outcome of the use of rolled metal in buildings, and a plan is now on foot to reduce the number of sections to only one-third of those now used by builders. It is expected in this way that quick deliveries for repairs can be made. There is not the same reason for standard sizes in wood, as if the wood is large enough it can always be reduced to the desired size.

Third. The height of cars will not be increased much above the dimensions of the 60,000 pound freight car on the Burlington road. This car is as high as is safe for train men, and the sills have been lowered until they occupy the place formerly taken by the draft sills. This gives the maximum interior height that may be expected. This car also has the maximum practical width for safety to train men and for clearances in tunnels. The width might be increased slightly.

(For dimensions of car see "Railroad Gazette," January 27, 1893, p. 68.)

Fourth. The length of cars for general service will not be increased much. Special service will require longer cars, but it is not believed that any standard car would be longer than the 36-foot car now used. There will be no difficulty in getting an agreement on the length of cars for ordinary service.

Fifth. In regard to the carrying capacity, the wide variation now common will disappear when steel under-frames are used, for the reason that such cars will carry a load of 100,000 pounds with a greater margin of safety than the present 60,000 pound cars carry their rated loads. One advantage that will arise from steel under-frames is that so far as the frame of the cars is concerned the load will not matter. The limitation to the loading will be found in the trucks. The large manufacturers of rolled sections are getting ready to enter the field of car construction with a rolled steel under-frame and a wood superstructure that will not cost any more than the present wooden cars. There will be a saving of weight of about 3,000 pounds per car, and the running repairs will be very much less, as the under-frames form a continuous draft gear of the best sort. The difficulty of repairs from wrecks of steel under-frames may, and undoubtedly will, be much increased, but as only a small percentage of the total freight car repairs arise from wrecks it is not considered logical that freight car con-

struction should be devised to reduce the repairs from wrecks, but should be devised to reduce the running repairs.

Sixth. There is a decided tendency towards an all metal truck and larger journals. Trucks entirely of metal have not in all cases given satisfaction, particularly those of the Diamond frame type. This arises from the fact that the joint between the transoms and the side-frames have been inadequate and they got loose. Enough experience has been had, however, to show that some types of all metal trucks require less repairs than a composite truck, and there is reason to believe that the all metal truck is the truck of the future. When trucks of that kind are properly made the running repairs will be very much smaller. It is generally believed that such trucks can be built for the same price as the common form of Diamond truck with the composite bolsters.

Seventh. Owing to the increased weight of truck frames and the wear of the joints of the brake gear, there is a general feeling among railroad men that there should be springs placed directly over the axle boxes and these springs should have sufficient capacity not to close under the oscillation of the heaviest load they receive. There might be other springs in the bolster. I am of the opinion that the small cracks that appear at the inner neck of the journals frequently arise from blows received from the closing of the springs when passing over rough tracks. These cracks spread until the journal breaks off.

P. F. Davis, General Freight Agent C. & W. M., and D., L. & N. System.

The standard box car should be of such dimensions as to be best adapted for the use of all classes of freight requiring box cars for transportation, and to permit of the loading, so far as practical, of the minimum weight of the many light and bulky articles now requiring transportation. For such purpose, my recommendation would be for a car forty feet in length inside, width the same as the present standard thirty-four foot car, and the height to be the maximum that will clear the present tunnels or other obstructions on the trunk lines, so as to permit of the free use of the cars by any route; with a capacity of 60,000 pounds. Such a car could be loaded to its full capacity with all coarse and heavy freight, and in most cases with the minimum weight now provided for in the tariffs for light and bulky articles. This car would come close to filling all the requirements of a box car, with a dead weight of about 30,000 pounds. It is true that a thirty-four foot box car of 60,000 pounds capacity will fill many of the requirements with a dead weight of about 25,000 pounds, but there is such a multitude of articles of commerce now which cannot be loaded to the required minimum in a thirty-four foot box car that the business of the country demands a car of larger size, and one which more nearly will meet all the requirements. The building of large cars has been forced upon the railroads, and in some cases individuals and private companies, by the necessity of the situation for cars that would enable the shipper to load the minimum weight of certain kinds of freight for which the railroads require pay for transporting. It does not

seem practical to make any very radical changes in the reduction of the present minima, because to do so would make the traffic unremunerative at the present rates, while to lower the minimum and advance the rates would not afford any relief to the shipper. The minimum weight provided for the various articles in the official classification, which governs on all traffic east of the Mississippi River north of the Ohio River to the Atlantic seaboard, is based on the earnings of a thirty-four foot car at 24,000 pounds from Chicago to New York. For example, most manufactured goods that will load 24,000 pounds in a box car are classified at fifth class, which rate from Chicago to New York is thirty cents per hundred pounds, which would make an earnings of seventy-two dollars. With new furniture of many varieties, only about ten thousand pounds can be loaded in a thirty-four foot box car, so that it is necessary to specify a minimum of 12,000 pounds and a rate of second class, which is sixty-five cents per hundred pounds, equaling earnings of seventy-eight dollars per car Chicago to New York, in order to make about what is considered the remunerative earnings for transporting a car of manufactured property from Chicago to New York. This minimum being placed on the property in the classification, that basis applies on the same property shipped between any two points in the territory previously described.

This situation has made it imperative on the part of the shipper to demand cars with a capacity that would permit of the loading of 12,000 pounds of furniture and other articles to the prescribed minimum.

The following table will give some idea as to the actual average weight of various articles that can be loaded into a thirty-four foot box car and the prescribed minimum weight for the same articles in the official classification, from statistics compiled by the chairman of the official classification committee.

	Average Actual Weight. Pounds.	Classification Minimum Weight. Pounds.
Agricultural implements	20,827	24,000
Binders and mowers	21,396	24,000
Corn planters	20,000	24,000
Corn shellers	15,766	20,000
Fanning mills	4,685	24,000
Grain cradles	2,000	20,000
Harrows	15,381	24,000
Hay carriers	12,000	24,000
Rakes, sulky	17,775	24,000
Seed drills	18.000	24,000
Barrels, ale or beer	16,942	20,000
Basket material	14,250	24,000
Baskets	6,750	12,000
Broom corn	11,700	14,000
Burial cases	10,242	24,000
Cans, tin, empty	15,377	20,000
Cooperage stock	15,000	24.000
Crackers	15,000	20,000
Crockery, in crates	17,908	24,000

	Average Actual Weight. Pounds.	Classifi Minimum Weight. Pounds.
Excelsior	18,037	20,000
Furniture, all kinds	10,274	12,000
Chairs, S. U. or Nested	10,725	16,000
Mattresses, woven wire	9,766	16,000
School furniture	19,787	24,000
Hay	19,737	20,000
Hides, dry	17,727	20,000
Household goods	5,300	12,000
Leather, in rolls	18,133	20,000
Lumber	21,054	24,000
Sash, doors and blinds	20,285	24,000
Trees, boxed	16,904	24,000
Trees, in bulk	10,000	20,000
Buggies	12,909	20,000
Vehicles	14,233	20,000
Cutters	3,625	20,000
Wagons, spring	13,333	20,000
Wheelbarrows	6,766	20,000
Butter plates, wooden	19,333	24,000
Butter tubs, wooden	15,153	20,000
Pails, wooden	15,816	24,000
Tubs, wash	13,985	24,000

These statistics show conclusively the necessity for box cars of large capacity. Then the question to decide is whether or not a box car should be made standard that will more nearly meet all the requirements of transportation. With a forty-foot box car, it can be loaded at any point with any kind of freight, by reason of its adaptability. I look upon it as settled that the large car has come to stay for certain requirements. They will be demanded and furnished. This requires the hauling of empty cars long distances many times to fill orders, while with a forty-foot car for a standard, any car at hand would supply the demand, and the interests of both the public and the railroad be better served.

REPORT OF THE COMMITTEE OF MECHANICAL SUPERINTENDENTS, APPOINTED BY THE CENTRAL TRAFFIC ASSOCIATION AND THE WESTERN FREIGHT ASSOCIATION.

(*Printed by Permission of Mr. J. W. Midgley, Chairman of the Western Freight Association.*)

Chicago, Ill., December, 1895.

G. R. Blanchard, Esq., Commissioner, Central Traffic Association :

J. W. Midgley, Esq., Chairman, Western Freight Association :

Gentlemen—The Committee on Dimensions of Cars, appointed as per

your circular of September 5th, 1895, sent to each member of that committee, respectfully submits the following report:

On the call of the chairman whom you nominated, Mr. Wm. Buchanan, a meeting of the committee was held in Chicago on September 19th. After a general discussion of the question, it was thought best, in view of your circulars of January 19th and August 5th, 1895, copies of which were sent to the members of this committee for their information, along with the notice of their appointment on the committee, to ask for certain information which these circulars intimated, your associations thought might be necessary for the proper determination of the main question. In pursuance of this plan, a circular was issued, dated October 26th, 1895, accompanied with two forms of report upon which returns were to be made.

Summary of Replies to Circular Letter of October 26, 1895.

Length.	Railroads.	Private Lines.	Total.
Box.			
Over 30 ft. and under 34 ft.	128,546	....	128,546
34 ft. and over, but under 36 ft.	38,967	350	39,317
36 ft. and over, but under 38 ft.	1,214	107	1,321
38 ft. and over, but under 40 ft.	383	78	461
40 ft. and over.	168	117	285
Stock.			
Over 30 ft. and under 34 ft.	12,973	....	12,973
34 ft. and over, but under 36 ft.	5,635	1,795	7,430
36 ft. and over, but under 38 ft.	2,152	7,216	9,368
38 ft. and over, but under 40 ft.	22	309	331
40 ft. and over.	99	350	449
Furniture, Etc.			
34 ft. and over, but under 36 ft.	180	....	180
36 ft. and over, but under 38 ft.	2,639	....	2,639
38 ft. and over, but under 40 ft.	3,206	....	3,206
40 ft. and over.	3,095	....	3,095
Refrigerator.			
34 ft. and over, but under 36 ft.	607	1,196	1,803
36 ft. and over, but under 38 ft.	150	483	633
38 ft. and over, but under 40 ft.	......	....	....
40 ft. and over.	......	....	....
Gondola.			
Over 30 ft. and under 34 ft.	51,069	....	51,069
34 ft. and over, but under 36 ft.	25,798	....	25,798
36 ft. and over, but under 38 ft.	......	....	....
38 ft. and over, but under 40 ft.	......	....	....
40 ft. and over.	......	...	....
Flat.			
34 ft. and over, but under 36 ft.	19,790	337	20,127
36 ft. and over, but under 38 ft.	2,100	1,088	3,188
38 ft. and over, but under 40 ft.	......	....	....
40 ft. and over.	1,911	66	1,977

On December 9th another meeting of the general committee was held to further consider the subject in the light of the returns received. It was

found that reports had been received from the owners of approximately seventy-five per cent. of the freight cars in the United States, and that the railroad companies responded more generally than the private car lines. When these circulars were sent out, it was thought best to limit the number of cars which were to be reported, and, therefore, no cars under 34 feet long were to be included in the report, but since the returns were received, we have estimated from Sechrist's Guide the number of box, stock and gondola cars between 30 feet and 34 feet long, owned by the companies which reported. The great majority of these cars between 30 feet and 34 feet are really between 33 feet and 34 feet, and very many of them nearly 34 feet long. Also, many of the cars which are reported as over 34 feet, but not 36 feet, are approximately 34 feet long. From the summary statement attached, prepared as above indicated, and from the facts as above stated as to 34 feet cars, you will see that a very large proportion of modern cars are approximately 34 feet long, leaving out of consideration for the moment, special cars for furniture, buggies, etc. This is a fact which we were all aware of, but we thought best to show it definitely as a basis for the conclusions recommended herein.

The detail reports received from the companies reporting are transmitted herewith, as they show the widths, heights, distance between truck centers, light weight and capacity of cars.

The committee did not ask for information concerning clearances through tunnels and past obstructions along the line of track, for the reason that it believes that the more this subject is generalized the smaller would be the car which could pass the clearances, and that any data procured on this subject would be useless, because each railroad company determines for itself whether cars will pass the clearances on its line or not, and it would not be proper to bring other restrictions against the movement of a given car in any service over any given line, than the restrictions which actually exist on that line.

The committee believes that it would be good economy to recognize 34 feet long inside of end sheathing, as a proper typical length, in view of existing circumstances, for box, stock and refrigerator cars, as well as for gondolas, measured inside of the boxes; also, to recognize 40 feet similarly as the length inside of end sheathing for furniture and buggy cars, and 36 feet measured over the end sills as the length of flat cars.

The committee also believes that it would not be economical to build any of these cars of above lengths for ordinary miscellaneous service of a greater capacity than 60,000 pounds for reasons which will appear below. (This is not intended to apply, however, to special cases where a large tonnage of exceptionally heavy freight, such as iron ore, is to be carried, justifies a special construction of car for such a service.)

The committee believes that the following table shows approximately the comparative cost of building box cars of different lengths of 60,000 pounds capacity:

34 feet long	$540 00
40 feet long	580 00
45 feet long	630 00
50 feet long	690 00

This table means that when the market price is such as to make a box car 34 feet long cost $540, box cars of the other lengths, when built of proper strength to stand service in modern trains equally well, will cost approximately the figures given opposite these lengths. It is impossible for the committee to give any accurate estimate as to the relative cost of maintaining cars of these different lengths, but the cost will be somewhat more for the longer cars. It is believed that the percentage of increase in cost of maintenance will be greater than the percentage of increase in first cost.

The annual reports of large railway systems giving the average tonnage hauled in cars, show that the average load is but a small fraction of the capacity of the car, and as it costs the same for actual haul to move a ton of car as it does to move a ton of freight it would seem to the committee that it is a question worthy of careful consideration whether a car of greater capacity than 60,000 pounds can be economically operated for miscellaneous business.

In regard to the lengths above recommended as typical for different classes of cars, we are practically driven to the length of 34 feet as an inside measurement for the cars given, because it may be considered prevalent practice, and because this length is necessary in order to get into a car a load of 60,000 pounds of staple articles such as grain, lumber, etc. We have named 36 feet as the length over end sills for flat cars principally because the same length of framing timbers required for a box car measuring 34 feet inside, will give slightly under 36 feet as the measurement over the end sills of a flat car. The length of furniture and buggy cars is stated at 40 feet principally because it has been customary to build such cars about this length. If they are not built stronger and more expensively than the 34 feet car, they should, of course, be marked at a lower carrying capacity, and the question as to whether it will pay a company to build such cars sufficiently strong to carry 60,000 pounds, so that they can be used for hauling grain when not needed in the furniture business, is a local one which we cannot undertake to determine.

Notwithstanding the above recommendations, this committee does not feel itself warranted in recommending any maximum lengths or maximum capacities for cars, because such a recommendation would necessarily be accompanied with exceptions as already above intimated, and the admission of such exceptions in one direction might be construed as carrying with it the admission of exceptions in the opposite direction, or the admission of longer cars if marked with a much lighter capacity for such service as carrying buggies. This, we believe, would be wrong, because a large element of the necessary strength in a car body in modern trains is its longitudinal strength in compression, considered as a column in a horizontal

position, and the tendency in building such long cars is to make them too weak in this direction, especially when they are built by individual companies having no transportation responsibilities.

In regard to the height and width of the bodies of box cars for ordinary service, the committee makes no recommendations, but can only state the prevalent practice is approximately 8 feet 6 inches wide inside, by 8 feet or 8 feet and a few inches high to the top of the plate, making the cross sectional area about 70 square feet, and the cubical contents of a car 34 feet long inside nearly 2,400 cubic feet.

A circular from the Western Classification Committee, dated November 15,1895, which has recently come to the attention of this committee, and a copy of which is herewith, shows the capacity of 34 feet cars for 39 articles of freight, and gives the present minimum weights at which carloads are billed. This table indicates, generally, that the capacity of 34 feet cars varies with some few exceptions from 10,000 pounds to 30,000 pounds on these articles, and that the present minimum weights vary similarly with few exceptions from 10,000 pounds to 20,000 pounds. These figures show that there are many items of freight which cannot be loaded in a modern car so as to give a lading of one-half the capacity of the car, and the minimum weights at which such items are billed show reasons for a strong inducement to exist in some localities for building cars of a greater bulk carrying capacity so as to get a weight of freight in the car approximately equal to what must be paid for. For instance, there is one case where 20,000 pounds is the minimum weight billed, while the capacity of the car is only 13,022 pounds, and another case where 20,000 pounds is the minimum weight billed, while the car has but 12,070 pounds capacity. Numerous other cases show facts tending in the same direction, and it is the belief of your committee that if these inducements to build cars of greater cubic contents did not exist, but rather that the minimum weights were fixed so that the modern car as built and owned by railroad companies would have the same chance as the larger and weaker cars which railroad companies are asked to haul in their trains, that the whole difficulty encountered by the association would be met, and that the building of such larger and weaker cars, which are a menace to the safety of the railroad company's trains, would cease.

By the rules of interchange, under which all railroad companies operate, each railroad company is its own judge as to whether it will receive any car, but the competition of different railroad companies often causes a railroad company to accept and transport a weaker car than it would otherwise handle, and the committee believes it is important that all inducements to the building of such cars by private companies or by railroad companies for general traffic, should be removed by making it unprofitable from a traffic standpoint, as it certainly is from an operating one. We do not believe that the building of such cars can be prohibited by any agreement between railroad companies, but that the only way to prevent building such cars is to render it unprofitable for any company to own them,

and if the minimum weights billed for were made such as could be loaded in a modern typical car for each class of freight and a proportionately heavier load required as the minimum for longer cars, we believe that the problem would be solved.

WM. BUCHANAN,	G. W. RHODES,	*Committee.*
E. D. BRONNER,	E. W. GRIEVES,	
JOHN HICKEY,	F. REARDEN,	
F. D. CASANAVE,	JOHN W. CLOUD,	
J. N. BARR,		

EXHIBIT *Showing the Average Weight per Lineal Foot of Carloads of Various Articles and Percentage of Weights per Lineal Foot to Minimum Carload Weights.*

NAME OF ARTICLES.	No. Cars Weighed.	Present Minimum Weights.	Average Weights per Lineal Foot, Loaded.	Capacity of 34-foot Cars.	Percentage of Weights per Lineal Foot to Minimum Carload Weights.
		Lbs.	Lbs.	Lbs.	
Apples	59	24,000	804	27,336	3.4
Barrels	38	20,000 7,000	383	13,022	1.9 5.5
Baskets	9	10,000	178	6,052	1.8
Broom corn	23	12,000	405	13,770	3.4
Cans	50	15,000	343	11,662	2.3
Coffins	14	10,000	358	12,172	3.6
Counters and shelving	5	10,000	171	5,814	1.7
Crackers	25	20,000	747	25,398	3.8
Cranberries	13	20,000	719	24,446	3.6
Dry hides	19	10,000	571	19,414	5.7
Fresh fish	38	20,000	830	28,220	4.2
Fruit jars	57	20,000	705	23,970	3.6
Furniture:					
Bank, store, saloon and office	9	10,000	275	9,350	2.8
Bedsteads	24	16,000	517	17,578	3.2
Chairs, common	39	14,000	388	13,192	2.8
N. O. S	50	10,000	324	11,016	3.2
School desks and seats	5	20,000	682	23,188	3.3
Tables	10	20,000	636	21,624	3.2
Wire mattresses	27	14,000	379	12,886	2.7
Ladders	5	10,000	320	10,880	3.2
Leather	35	20,000	763	25,942	3.8
Leather scrap	5	20,000	588	19,992	2.9
Matches	39	20,000	750	25,500	3.8
Merry-go-rounds	20	15,000	450	15,310	3.0
Moss	12	20,000	355	12,070	1.8
Paper bags	15	20,000	693	23,562	3.5
Rags	48	20,000	617	20,978	3.1
Refrigerators	23	16,000	436	14,824	2.7
Sawdust	61	20,000	786	26,724	3.9
Shavings	25	20,000	679	23,086	3.4
Stoves	58	20,000	759	25,806	3.8
Tanners' bark	65	20,000	916	31,144	4.6
Tents	6	20,000	446	15,164	2.2
Vehicles, light	94	12,000	284	9,656	2.4
Wagons	63	24,000	677	23,018	2.8
Washing machines	12	20,000	437	14,858	2.2
Wind mills	39	20,000	844	28,696	4.2
Wooden ware	48	12,000	458	15,572	3.8
Total	1,087				
Average for 39 articles	...	16,692	530	.....	3.1

REPORT OF THE WESTERN CLASSIFICATION COMMITTEE.

CHICAGO, ILL., NOV. 15, 1895. THE "ROOKERY," ROOM 733.

DEAR SIR:

At late meeting of this committee the chairman was requested to submit a proposition to members for vote, providing for the equalization of charges on freight loaded in and on cars of differing sizes. This question is one which has enlisted the interest of traffic and operating officials for some time, and just now, in the face of a threatened car famine, is of the highest importance. It seems to have been the feeling in some quarters, that the only way to insure the use of cars of ordinary or small capacity, was to stop building large ones, as the latter have, at least until recently, been demanded, and in many instances hauled long distances to load light and bulky freight, while at the same time smaller cars were left idle on the side tracks at stations ordering the large cars. The remedy proposed (stopping the building of larger cars), while it would forfeit the manifest economies realized in the use of large equipment, is not radical enough to remedy the existing disparity between large and small cars. The building of cars of large box and axle capacity is not necessarily an evil, but has resulted in effecting large economies in the cost of freight service, and just what the limit to the size of car-boxes is, beyond which it ceases to be an advantage to go, is purely a mechanical and operating problem; it is only incumbent on the traffic department to provide such minimum weights and rules as will insure the full use of equipment without discrimination against any part of it. Cars of 60,000 pounds capacity are being operated with entire safety, and it would appear that the cost of moving a given tonnage with cars of this capacity should not be more than 40 per cent. of that of moving the same traffic in cars of 30,000 pounds capacity, providing the cars are fully utilized. To promote such utilization is the object of the proposition herewith submitted, which is as follows:

The minimum weights provided in the classification by rule six, and in the body of the classification to apply on shipments loaded in and on 34 foot cars, and an addition of three per cent. per foot to be made to minimum weight for each foot or fraction thereof in excess of 34 feet outside measurement. An analysis of 1,087 cars weighed by the Western Weighing Association, indicates that three per cent. per foot is the proper addition to make, to cover the additional loading capacity in excess of 34 feet. (See exhibit above.) With but few exceptions, the minimum weights now provided in the classification are such as can be loaded in 34 foot cars. The proposition herewith submitted, will, if adopted and enforced, add largely to the efficiency of freight equipment, and realize the same results as building new cars without the expense of such construction. Under the operation of the rule, large cars would go where they could be used to their full capacity, and thus realize the large economies incident to their use, and shippers have a larger supply of cars than is now available. It is

seldom that a troublesome transportation problem admits of so simple and efficient a solution as the one herein proposed. Please advise your vote on the proposition after giving the matter your careful consideration.

J. T. Ripley, *Chairman.*

The PRESIDENT—Gentlemen, the subject is now open for discussion. I hope we will hear from a large number. Mr. Mendenhall, won't you start the ball rolling?

Mr. MENDENHALL—Mr. President, I think the Committee should have a vote of thanks for this report. I have read it over very carefully, and I must say that they have covered the ground very well, but in reading it, together with the letters which follow, especially those of Commissioner Goddard and Mr. Bird, it strikes me as an intimation that the traffic departments of our railroads have been out of touch with the transportation departments, and these two letters in particular are very interesting to me, and would seem to explain in a measure why the large car problem has been presented to us. Of course, there are other considerations, as have been explained by our Committee, but I cannot help feeling that this one is the strong one. If we are to have a rating by space in our box cars, and thereby overcome the difficulties of assigning small cars to general traffic, the probabilities are that the difference in the size of box cars will not be as much of a disturbing element as it is to-day. As far as the size of gondola cars is concerned, it would seem that in a very short time we are going to reach a capacity greater than that recommended in the report of the Committee. Gondola cars in this country are used almost exclusively for the transportation of coal, coke and iron ore. A car within the dimensions recommended can be made to carry 100,000 pounds, and undoubtedly that car will be built. Probably it may be stated in this case that this is a special service, but it is such a large service that it is a general one.

I do not think of anything in the report which I can criticise, except possibly the remark about the sides of the gondola car acting as girders, and recommending that the sides be placed down on the side-sills instead of on the top of the floor. I think that is open to a good deal of discussion. There are many reasons why it is better to put the sides on top of the floor, and there is some question in my mind as to whether or not the strength is impaired by doing so.

The PRESIDENT—We have with us to-night the ex-President of the New England Club, Mr. Chamberlin. Mr. Chamberlin, will you give us your views on the large car question derived from your experience in New England? Gentlemen, Mr. Chamberlin.

Mr. CHAMBERLIN—Mr. President, I do not know as I can say anything that will interest you. I have hardly had a chance to read over this report, although I intend, if occasion arises, to say something later. This Committee sent to me a circular asking for information, and it is barely possible that I may have given them the wrong information.

There seems to be two questions in the subject, most of which is spoken of as "Large Cars." I suppose that entails, however, cars of greater capacity than the heavy cars now generally built by the railroads. As far as the cars of larger dimensions are concerned, as to height and width, I can only speak from my own experience in the East, where we have low bridges and tunnels of dimensions built to take safely the car of twenty years ago. In other words, the 8 x 28 feet box cars, and we are troubled a great deal on account of the modern large furniture cars coming into our section of the country. We cannot get them, with the brake-staffs on top, through our bridges. That, however, I presume, is a local issue with us, and the roads in the Western part of the country are not troubled in that respect. As regards the car of larger capacity—I mean by that a car to carry a heavier load—I believe that 60,000 pounds is about the capacity that we should go. I realize the fact that there are special cars in special service, open cars and cars that are running between two points, and that it would be perfectly economical to construct these cars to carry 70,000, 80,000 or more pounds, but for the indiscriminate freight traffic I believe that the car of the capacity of 60,000 pounds is about as large as the railroads can haul economically. I remember, when I was connected with the Albany Road, this matter of car-loads came up, and I went into it very carefully. I went to the freight department, and to my surprise I ascertained—this was some time prior to 1888—to my surprise I ascertained that the average weight of freight per car arriving at Boston over the Albany Road was somewhere between seven and eight tons. The traffic has since increased, and no doubt the load, but that it has increased so that the average load will be over 60,000 pounds, I question very much.

There is another thing that enters into the subject, and that is the matter of bridges and of track. The heavier your rolling stock, the heavier you must make your bridges and track, in fact, the whole maintenance of way has got to be increased proportionately to meet any additional weight, for if you increase the capacity of your car you certainly have got to strengthen your parts. As far as the road with which I am connected, outside of the coal traffic, I presume 60,000 pounds is plenty large enough for us, and I believe that is true of roads generally, except, as I say, for cars for special service.

Mr. MITCHELL—When this subject was first brought before the Trunk Line Commission our President asked me to look into it. I think that was about a year ago. I have been looking into it ever since, and the more I study it the larger becomes the question. The first thing I did in investigating the subject was to look into the question of the difference in the cost of maintenance of the 60,000, 40,000 and 30,000 capacity cars, and I found that it cost practically no more to maintain the modern car, which was much stronger, than it did the old style and weaker car. I then decided that the large 70,000-pounds capacity car could be built and operated, so far as repairs were concerned, nearly as cheaply as the old

style weaker and smaller car. I then considered the breaking load, where possible, of cars running to-day and costing the least for repairs, obtained the factor of safety for such cars, and then figured on the timber, etc., to use to build a large capacity 70,000 or 80,000-pounds car, after which I made some figures as to their earning capacity, which I have sent to the committee to be printed. I found that figures would give you any result that you wanted, and that the system of figuring shown herein would demonstrate that the larger capacity cars earned more money than the smaller cars, provided they were loaded to their full capacity one way and only partially loaded on their return trip. The same method of figuring will show that the larger the capacity of the car the more money would be earned if the conditions were lived up to; hence the fallacy of such figures, as other points must be considered in connection therewith, viz.: strength of materials, condition of bridges and roadbed, etc., if expected results are to be considered.

Then the next thing that I figured on was, considering that the locomotive had passed over the rails at the front end of the train, would any one car behind that engine do any more damage to the track than the engine had done. In my judgment, without consulting the roadway department, I did not find that a car could do more damage to track than the average locomotive, especially those with small wheels, running at high speed. I see, however, that one chief engineer says the opposite, but I find under that ruling that an 80,000-pounds capacity car weighing 34,000 pounds, and carrying 80,000 pounds of lading, the load on any panel point of a bridge, and the spacing of the wheels between the forward truck of one car and the rear truck of the other car ahead of it, would be just about the same as the spacing of a consolidation engine, and that the strain on the roadway would be no greater practically in one case than it would be in the other, but when I got to that point I met an expert consulting engineer of this city, and I asked him some questions, and he propounded some questions in reply, some of which I have included in my letter to the Committee. Those questions are something that must be answered by the roadway department to a great extent, and after further studying the question, I believe that the only solution of this problem is to let the traffic department change their rating some way, so that the large capacity car would not be in any more demand than the small capacity car, so far as a shipment is concerned. If the rates are some way based on cubic feet capacity, as recommended by Commissioner Goddard, and then the different classifications cover the weight, it seems to me that is the simplest way out of it. I for one do not believe we want to build much heavier cars than 60,000 pounds capacity, unless we go to metal construction.

The PRESIDENT—What is the height of your last car, Mr. Mitchell?

Mr. MITCHELL—The dimensions of our 60,000-pounds capacity box car are:

Length over end sills	35 feet	0 inches.	
Width over side sills	8 "	9¾	"
Width over eaves	9 "	6½	"
Height from top of rail to eaves	11 "	10½	"

The PRESIDENT—It does seem to me that some limit should be put upon the height of box cars. The railroad companies have been called upon by our Legislatures to spend an enormous amount of money to protect trainmen, and they are going right along building cars that will hardly go under some of the bridges and through tunnels in the East. They are much more dangerous, in my opinion, to trainmen than the old style of coupler and cars without grab-irons, and I think that the railroads should decide on something about the height of cars, if on no other dimension.

Mr. TRATMAN—The general impression to be gathered from the report and the appendices is that the "large car" question is mainly a question of rates, and can be promptly settled by concerted action on the part of the traffic departments.

Referring to page 2, as the committee states that it is not aware of any box cars of more than 60,000 pounds capacity having been constructed, it may be of interest to mention that the Northern Pacific R.R. built at its own shops, in 1895, about 200 box cars of 70,000 pounds capacity for the grain traffic. These cars have six sills, 5 x 9 inches, and four 1½-inch truss rods. The body bolsters are of iron plates riveted together, and Fox steel trucks, with 33-inch wheels, are used. The dimensions of these cars are as follows:

Length over end sills	42 feet	0 inches.	
Length inside	41 "	0	"
Width over side sills	9 "	1	"
Width inside	8 "	6	"
Width over eaves	9 "	11⅛	"
Height from sill to roof plate	7 "	7	"
Height from rail to eaves	11 "	9	"
Height from rail to top of roof	12 "	5½	"
Height from rail to bottom of sill	2 "	7¼	"
Height from rail to center of coupler	2 "	10¾	"
Wheelbase, truck	5 "	2	"
Wheelbase, total	37 "	0	"
Distance, c. to c. of trucks	32 "	0	"
Body, cross section	77 sq. feet.		
Body, cubic capacity	3,157 cubic feet.		
Weight of body	20,000 lbs.		
Weight of two trucks	12,000 "		
Weight, total, empty	32,000 "		
Weight, total, with full load	102,000 "		

In regard to the committee's recommendation for a 70,000-pounds car, on page 11, I would ask how many sills it proposes to use.

As to the question of the relative amount of damage to the track due to the locomotives and cars, I am inclined to think that the locomotive driving wheels are by far the most destructive, owing to their greater wheel loads, the frequent destructive effects due to bad counterbalancing, and the wear by sand and slipping wheels. This would be the case even if the car wheels carried the same weight as the engine wheels. The heavy consolidation engines of the Erie R.R. have driving axle loads of 25,000 to 32,800 pounds, while the ten-wheel freight engines have axle loads of 36,750 to 38,750 pounds. It is true that fully loaded cars of 70,000 and 80,000 pounds capacity would have axle loads of over 25,000 pounds, but in the bulk of existing traffic, with 40,000 to 60,000-pounds cars, the actual loads are only about 16,000 to 20,000 pounds per axle. While flat spots on car wheels will of course aggravate the destructive effect on the track, an aggravated case of bad car wheel will be less injurious than an aggravated case of badly counterbalanced engine or worn driving wheels.

Taking up the list of questions given by Mr. Mitchell, on page 32, I may briefly deal with the first two questions:

1. Even if the car has the same weight per running foot as the locomotive, it cannot be considered equally destructive to the track, since the car is merely a passive rolling weight, while the locomotive exercises destructive influences due to faulty counterbalancing, slipping of drivers, use of sand, etc., to say nothing of the wear of frogs and switches by badly worn driving-wheel tires. It has been estimated, as the result of investigation, that from 60 to 75 per cent. of the damage to track is due to the locomotive, or to the locomotive mileage. While the general introduction of heavy cars might increase the proportion of damage due to car wheels or trains, it is not probable that the proportion would approach that due to the engine wheels.

2. Can the weight per running foot of cars in the train equal or exceed that of the locomotive without excess damage to the track? I should answer "Yes" to this, pointing out, however, that the rate per running foot is not of much use in dealing with effect on the track. In Wellington's "Economic Theory of Railway Location," 1887, it is stated that the Baltimore & Ohio R.R. had a number of coal cars 21 feet long over all, carrying 50,000 pounds, and weighing, fully loaded, 76,000 pounds, or 3,619 pounds per running foot, while consolidation engines had a weight of 3,100 to 3,275 pounds per running foot. The 70,000-pounds cars of the Northern Pacific R.R., to which I have referred, weigh, fully loaded, 102,000 pounds, or 2,372 pounds per foot. The heavy Erie R.R. consolidation engines weigh 131,600 pounds, and the ten-wheel engines 138,100 pounds, on a length of 32½ feet, from bumper beam to back of firebox, or 4,094 and 4,249 pounds per running foot. If we add the weights of the loaded tenders, and take the entire length, from nose of pilot to back of tender coupling, we get loads of 3,503 and 3,598 pounds per running

foot. It may be noted that heavy sleeping and mail cars weigh only about 1,200 pounds per foot.

The weight per running foot, however, does not seem to be a very practicable or useful method of comparison in regard to damage to track, since it is the intensity of wheel load rather than the actual distributed total train load that is in direct relation to the damage. For instance, a road with comparatively light track might put six-wheel trucks under the 70,000-pounds cars, thus reducing the axle loads from 25,500 to 17,000, while practically retaining the weight of 2,372 pounds per foot. The Northern Pacific R.R. 70,000-pounds car has a total load of 102,000 pounds (or four axle loads of 25,500 pounds) on a wheelbase of 37 feet, or on two trucks of 5 feet wheelbase. The Erie R.R. ten-wheel engine, however, has a driving wheel load of 111,750 pounds (or three axle loads averaging 37,250 pounds) on a wheelbase of 12 feet. Then, again, it must be borne in mind that the locomotive loads are standard, while the car loads are fluctuating, according to the weight of freight, the figures given above representing the maximum, which as yet occur very rarely in regular freight service. Under these conditions it certainly seems that the locomotive must exercise by far the greater destructive effects upon the track.

There is one other view of the matter, however, and that is in regard to the track upon which these train loads and axle loads are imposed, and it certainly appears that these loads have been increased beyond the economical capacity of any but the largest trunk line tracks. In saying this, I refer to present conditions and not to the possibilities of a further increase in car wheel loads, for on very many roads the track is now far below the requirements of both economy and safety. This question, however, is rather beyond the line of the present discussion.

Mr. PHILLIPS—I am sorry to say I am not in a position to discuss this question, inasmuch as I have been away during the week, but it is noticeable that while this question was considered one of easy solution, and that a little investigation would determine what could be done towards limiting the size of the cars, it is like a snowball that gathers material as it moves along, and it becomes more difficult of solution as new problems gather around the original one. It seems to me, generally speaking, that there should be some limit in view of the difficulties that arise from a mechanical standpoint, as well as other considerations. The extent to which the building of these large cars has been carried has caused ridicule not only among the railroads, but among shippers of freight. At a recent meeting of some association composed of persons interested in the bulky class of freight traffic, one of them stated that he had seen chalked upon the side of a freight car this parody on a well-known couplet:

Ho, little box car, don't you cry,
You'll be a freight house by and by.

The PRESIDENT—We have with us a gentleman who has disposed

of the small car problem recently, and can no doubt give us some points on the large car problem—Mr. Bradley.

Mr. BRADLEY—Mr. President, I wish I could. I know something about the small car problem, but I am frank to say that I know very little on this question of limiting the size of cars; but in looking at all phases of the subject, from a traffic standpoint, a commercial standpoint, and from what railroads generally are doing, I do not think that they are doing what should be done to promote the best commercial interests of the whole country. A coal firm takes away from our Weehawken terminal with a team of mules, a truck load of coal, a load that weighs three times as much as the truck on which the coal is carried, and the driver on top of it. I do not see that any of the figures referred to repeatedly here show that any of the railroads are doing as well as these people who load and haul coal, and following along this line it seems to me that in that direction an improvement is possible by hauling more paying tons to the dead weight, and I think the time has come when we should call a halt on these increasing large cars, and strive to get larger loads in the cars we now have. I am entirely satisfied that no car should be built to carry over 60,000 pounds.

The PRESIDENT—Mr. Donnelly, we are always glad to hear from you.

Mr. DONNELLY—It is a subject I have not studied very thoroughly, in fact I did not know what the subject was to be when I came here to-night, and I would rather listen to some other members. However, I do not favor cars of greater size or capacity than they are now using.

Mr. DEMAREST—Mr. President, I do not know that I can say very much about it. I just got this report a few minutes ago, and have not had a chance to look it over, but in reference to the extremely large cars I will say to start with that I am opposed to them, and always have been. I am pretty well satisfied that we are at the extreme limit with the 60,000-pounds car, for practical purposes. The question of what the car would haul of different kinds of freight, that is a matter that I do not think enters into the subject at all. or should not enter into it. The great trouble with the large car is in the point our friend spoke about in regard to the team hauling coal. You must understand that this is a single team. Now, if you load cars in that way it is not a single team. It becomes a single team at some time, it is very true. When you take them down into yards to shift you have got a single team, and what becomes of them? It goes along until it strikes the balance of the team. and smashes not only itself but something else, and that is where the trouble is with these large cars. It is not that you cannot build a car that will run over the tracks—that is not where the damage is done, that is not where your rolling stock is broken to pieces—it is in your yards, and the heavier you build them the more damage you will have. That is where you have got to look if you construct those large cars.

Mr. FOWLER—Attention has been called to the report of the com-

mittee where reference is made to cars of 60,000 pounds capacity as the largest that they had knowledge of, in connection with this Northern Pacific 70,000-pounds car. That was true in so far as the committee was aware. I did not know of this Northern Pacific car until after this report had gone to print. Since that time I have seen drawings of this large car of the Northern Pacific Road, to which attention has been called, and it seems that it demonstrates that the limit has about been reached. This car has four 1½ inch truss rods, and yet those truss rods won't carry the strain which would naturally fall upon the cross-tie timbers if the framing was supposed to be equally supported at the bolsters and at the cross-tie timbers. The drawbar runs through the end sills. I have forgotten what the height of the car is. The wheat line is 55 inches from the floor, but the oat line is just below the plate, so that it is impossible to carry 70,000 pounds of oats in the car. In all respects the car is most admirably designed. They have taken advantage of everything they could to so design it that it would car. In other respects the car is most admirably designed. They have taken advantage of everything they could to so design it that it would properly carry the strain, and yet, in spite of this fact that they have these four 1½-inch truss rods, they have not sufficient strength to carry the static load that would naturally fall upon them. If they had six of these truss rods, they would have enough to carry the strain. Four is not enough, if we keep the tensile strain of the metal at 10,000 pounds per square inch.

The PRESIDENT—I would like to ask Mr. Mitchell for the data he has in regard to the expense of maintenance due to the superior construction of the new car over the old. You said, I believe, that the cost of maintaining the lighter capacity car was about equal to the larger capacity car.

Mr. MITCHELL—I will answer President West, that it is. In the construction of the larger capacity car we figure to avoid the difficulties of the past. Their construction is superior, and they have stronger draft rigging. I have substituted in the last three years malleable iron in all freight car construction in place of cast. In doing it we have reduced the dead weight 900 pounds, and we have also reduced the dead weight full 1,100 pounds by using Fox trucks. I have reduced the weight of the old style cars by that means, too. I might add here something with regard to the remark made by Mr. Mendenhall about the sides of coal cars. I do not think you can depend anything on the side-boards to stiffen the car except possibly when the car is new, for the reason that if you look at any car two or three years old you will find the side-boards are 1 inch to 1½ inches apart, and unless you keep those boards tight in order to make a solid frame on the sides, I do not think you can depend much on the sides to support the car. A party told me the other day that he was drawing his boards together in order to keep the coal from leaking out. I believe, as the committe has recommended, that we have got

to depend upon the floor system and truss-rods to carry the load in almost every car.

Mr. MENDENHALL—Reference is made in some part of this report to our present methods of rating being a stimulus to the building of private line cars, and in that connection I want to state that I think the demands of to-day will limit the height and width of box cars without any action on our part. This has been brought to my attention very noticeably this week. One of the private car lines operating cars from California all through the East have had their cars tied up in half a dozen States on account of their being too wide—at the height of eaves of the ordinary 60,000-pounds box cars.

Mr. RICHARDS—I, together with other members of this august body, have been somewhat interested in the car question, and I have aired my convictions at some length in "Locomotive Engineering" on several occasions, and my reasons for the ground taken there are influenced principally by an experience I had on a Western road a few years ago in making some extensive locomotive tests. We had a compound locomotive and a simple locomotive in the test, and it was to determine the relative economy of the two engines in fuel consumption, among other things, and we had weighed loads—that was stipulated. At the inception of the test it was arranged that we should have loads to the full capacity of the engines, and in the several weeks occupied in that test I never found a load greater that 25 tons to the car, and they were picked loads in every case filled out to get cars to the capacity of the engines. That is why I take the ground that the average load ought to govern in the construction of a box car which it is made to meet, and the fact that we never could find a car with a greater load than 25 tons convinced me that that ought to be the capacity of a large box car; and that was on a road where the average traffic was as heavy as you will find it most any place in the country. This Northern Pacific car that has been referred to is 41 feet outside of sills, as I believe—I have not read the report. Now, in between the bolsters of that car there will be at least 32 feet, and that means a serious deflection in the sills if the truss rods are not heavy enough to carry the load. In this case they are 1½ inches, I believe, and it would be an interesting problem for those who are mathematical experts to dig out the strains here. A gentleman has remarked here that they would not probably show up anything like safe loads on the truss rods. Probably not—but there is a point. If those truss rods are increased to the proper size to carry the loads, it increases the dead weight on the car, and if the dead weight is increased, I cannot see any good reason why the 60,000-pounds car, as we have to-day, is not heavy enough, provided the 25-ton average load is the lading that that car will carry.

Mr. WHEATLY—Mr. Chairman, there seems to be very little criticism of this report. The committee had expected to find a great many of the gentlemen here disagree with its conclusions. We are very much gratified if silence on these points signifies that the Club agrees with us.

There are one or two points in particular just now that I would like to bring forward and ascertain if the members of the Club really do agree with the committee. One of the points which it has made with respect to the limits on cars is that it would be wise to exclude from the interchange service all four-wheel cars and all eight-wheel cars of less than 40,000 pounds capacity, and with respect to box cars, whose cubic capacity is the factor of consequence, the committee thinks that 1,500 cubic feet should be the minimum limit. Is it not just as necessary to take those small weak cars out of service as it is to place a minimum limit upon the capacity of large cars? The discussion of the large car problem was started in some of the traffic associations with the object of placing a limit ultimately upon the maximum dimensions and capacity of cars. This committee has made some recommendations upon that point. They have settled upon 70,000 pounds for box cars and 80,000 pounds for other cars. The committee's reason for naming those figures is that we now have in our interchange service some open cars of 80,000 pounds capacity. One gentleman has informed the committee that the Northern Pacific has some box cars of 70,000 pounds capacity. The committee did not want to place a limit upon the maximum capacity of cars that would not allow for any growth hereafter, and certainly would not feel warranted in placing a limit lower than some roads are now using. One of the gentlemen who spoke referred to the fact that the heaviest load he had seen in a box car was 25 tons. Since this report was printed I have received a letter from an officer of one of the trunk line roads giving a few figures as to tonnage which I think would be of interest to the Club, and I will read them, as follows:

"Without going into extensive details, I will give you for your information the net results of our experience since we commenced, about one year ago, to watch the tonnage.

The following are three instances which illustrate our maximum train loads, east-bound.

First Train—44 loaded cars, mostly grain, and caboose. Paying load, 1,048 tons; dead load, 582 tons; total, 1,630 tons.

Second Train—45 loaded cars, mostly coal, and caboose. Paying load, 1,216 tons; dead load cars, 553 tons; total, 1,769 tons.

Third Train—44 loaded cars, mostly coal, and caboose. Paying load, 1,192 tons; dead load cars, 545 tons; total, 1,737 tons.

Our average maximum train load east-bound would therefore be about 1,152 tons paying freight, 560 tons dead weight of cars and caboose, making a total of 1,712 tons per train, or about 67 per cent. of paying load and about 33 per cent. of dead weight. Some of the cars are 40,000 pounds capacity, and some 60,000 pounds capacity.

You will notice, however, that the above figures are based on train loads of heavy freight, such as grain and coal, and represents our maximum train load under favorable conditions. Our general average train load east-bound with all classes of freight (light and heavy), under varying

conditions of speed and weather, with the same class of engines hauling the three trains given above, is about 1,200 tons per train. The general average relative proportion of paying load and dead weight east-bound is about 744 tons, or 62 per cent. paying load, and 456 tons, or 38 per cent. of dead weight per train.

As to the average weights per car and the average proportions per car of paying load and dead weight for different classes of commodities east-bound, I give you the following figures, taken from our records:

Box cars (principally grain and the products of agriculture) average 30 tons, of which 18 tons, or 60 per cent., is paying load, and 12 tons, or 40 per cent., is dead load. Refrigerator and stock cars (principally with dressed beef, provisions, dairy products, live stock, etc.) average 30 tons, of which 13 tons, or 43 per cent., is paying load, and 17 tons, or 57 per cent. is dead load. Coal and flat cars (prinicpally with coal, ores, lumber, stone, etc.) average 35 tons, of which 23 tons, or 65 per cent., is paying load, and 12 tons, or 35 per cent., is dead load. Please note that these averages are based on both large and small capacity cars.

At certain seasons a very large part of the east-bound tonnage of the trunk roads between the Western grain fields and the Eastern seaboard consists of wheat and corn, on which, when taken alone, the average weight per car is higher than any of the figures given. Frequently this stuff is moved in solid trains, on which the average weight per car is generally about 37 tons, of which 24 tons, or 65 per cent., is paying load, and 13 tons, or 35 per cent., is dead load. In some cases, where a string of 60,000-pounds capacity cars are run into the elevators, we get a plump average of 44 tons per car, of which 30 tons, or 68 per cent., is paying load, and 14 tons, or 32 per cent., is dead load.

I have said nothing herein about the average lading of the different classes of cars west-bound, for the reason that on nearly all the East and West trunk line roads the heavy traffic stream is east-bound. Cars always move in the opposite direction empty, or with light loads. The average paying load west-bound, in box cars, is about seven to eight tons. Coal and stock cars always move empty; refrigerator and flat cars nearly always do so."

That is the experience of one of the trunk line roads, and I can say also that it is very similar to our own. We frequently, in handling grain, get very heavy loads in our box cars. As was said in this club when we were discussing the tonnage problem, the question of the economy of large cars is a question that refers to the movement of the traffic in the direction in which it is running heaviest. Cars moving in the opposite direction will always move empty or with light loads. The committee wishes to be understood that it has not attempted arbitrarily to place either maximum or minimum limits upon the dimensions and capacity of cars. It has, however, attempted to show that certain limits are already established by considerations of good workmanship in construction, and by considerations of economy and safety in maintenance and operation.

The committee has endeavored to take broad ground, upon which all the varied railroad interests can stand without crowding one another. It believes it has occupied such ground when it says it is not feasible with the present materials and designs used in car construction to attempt to carry heavier loads than 70,000 pounds, or possibly 80,000 pounds, or to construct cars of a greater length, inside measurement, than 36 feet for carrying the heavier loads. The committee thinks it would be wise, all things considered, to do away with the double standard of box cars, one for the light bulky freight and another for the heavy freight, and to fix upon a single standard that shall be available for all classes of freight. No more of the large weak "Jumbo" cars should be built, and those that are now in existence should be confined to the service of the home road along with the small weak cars. The standard box car for general interchange service should slightly exceed in cubic capacity the ordinary box cars of to-day. It should have a storage capacity of 2,210 to 2,700 cubic feet; probably 2,500 cubic feet would satisfy everybody after the traffic people have changed their minimum weights in the classification.

In support of its contention for a standard roofed car the committee takes the broad ground that since the interchange of cars is a reciprocal function, and the roofed cars of the various roads wander about over the country, from Maine to California, it should be the aim to build such cars with due regard to the general requirements of the whole railway system. Cars that are built for special adaptation to the local requirements of one road, and are not adapted to the general traffic service, should be kept strictly in the local service of their owners. The committee thinks this position is practically unassailable.

The all steel car, with which it may be possible and feasible to further increase the weight carrying capacity, has not yet been built. It may at some future time enter into the consideration of this question. When it does make its appearance, the problem raised by Mr. Parke, of the effective control, by the air brakes, of trains made up of these heavily loaded cars will, I think, be as hard a nut for operating officers to crack as any they have wrestled with in past years. Even now, with our present 60,000 to 80,000 pounds cars, fully loaded, it is becoming a vital question. The statement that the speed of the loaded trains, made up of these heavily loaded cars, must necessarily be slower, if the same control is to be maintained, does not answer the question. The demand is now, not for lower speeds, but for higher speeds on all classes of traffic; and that demand is likely to continue, and all railroads will endeavor to meet it. How is it going to be done with safety if the carload is increased beyond 60,000 to 80,000 pounds?

Mr. BLACKALL—Mr. President, I favor a 60,000-pounds car. I think they are large enough. All cars that our company has built the last year are of that capacity. In talking with our chief engineer only a few days ago on this problem, he said that there was more damage done to the track by heavy capacity cars than by locomotives on account of the con-

dition of many of the wheels under our freight cars. He said he was out a few days previous and examined a bridge and cars passing over there with wheels more or less worn. As far as my opinion is concerned, I think 60,000-pounds capacity cars are large enough.

The PRESIDENT—Mr. Blackall, there is one other point I think you could give the Club information on. Mr. Wheatly has called attention to the recommendation to exclude from interchange the four-wheel cars. What conclusion does your experience lead you to on that questiion?

Mr. BLACKALL—We have several thousand four-wheel cars, and as good cars as any running on rails, but we do not ask any connection to take them. We have business enough at home to take these cars.

Mr. FERGUSON—It has been remarked here several times that the more this question is discussed the larger the field for discussion appears to grow, and I do not care to add any more field if I could, but there was one thing mentioned in reading the report of the committee which has passed unchallenged, and that is there seems to be so much stress laid on the fact of the truss rods on a box car carrying all of the load in the car, and that the bracing on the sides serves little or no purpose in that direction. The side bracing, it is true, does not appear to do much good, and the reason that is advanced is in the construction of the car, and that the shrinkage of the timbers and the laxity of the inspection in cars, prevents their doing much good. It occurs to me that if the question of the poor construction of a car is to enter into it, we will never get to the bottom of it. Supposing that the construction is done properly, the side-bracing should sustain a large part of the load the car is intended to carry. The road with which I am connected, the Pennsylvania, when they build box cars it is a very prime factor in the inspection that the car shall have a certain camber before the truss rods are tightened up at all, and this certain camber should carry a good deal of the load before the car settles down to put the full downward thrust on the truss rods.

Mr. MITCHELL—I think I referred to coal cars. It is the coal cars with 2 inch boards, or sometimes 3 inches, which shrink so that you can see between the boards.

The PRESIDENT—And sometimes they shrink so far apart that the coal sifts out.

Mr. MOLYNEUX—Speaking of coal cars, and the sides acting as a plate girder, I certainly agree with Mr. Mitchell. The car sides will shrink, and also the sides of the car swell out from the load, and if they are in that condition, I do not see how they can act as a plate girder, that is, the center of the car will be wider than at the ends, and I think that destroys the strength of the plate girder.

It has been stated in some of the papers about the loading of freight trains by tonnage instead of by cars, that some superintendents report an increased haulage capacity by rating trains in that way, in some cases 7-10ths, and where the freight is miscellaneous, of 17-20ths. If the present cars are not loaded to their capacity, why go to larger cars? The

Western roads are those who have favored larger cars in cubic capacity. The Eastern roads cannot do that, by reason of bridges and tunnels. Will not the Western roads feel this more and more as the highway grade crossings are eliminated. Take the State of New York, and they are getting rid of the grade crossings, and the movement in this direction will increase as the years go on.

Something has been said about the car of large tonnage capacity in the yard service being broken, of that heavy car striking another one and hurting itself, as well as the other one. That is so, but there are fewer cars to handle. You take the four-wheel cars. For the same capacity, on our road, you would have four four-wheel cars to one gondola car. If you are switching you have four cars with four brakes to be tended, whereas if you have a gondola you have two brakes. I think the Lehigh Valley found that the breakage from gondolas was very much less than with four-wheel cars.

The PRESIDENT—We have with us to-night one of our Pennsylvania Railroad friends—I cannot speak his name at the moment—we would be glad to hear from him—Mr. Foshay (?)

Mr. FOSHAY—I am much obliged to you, Mr. President, for calling on me, but I do not know that I can add much to this subject. It is a little out of my line just now, and not having studied it, I cannot say very much. But it seems to me that it is very much a matter to be decided by the traffic requirements. If cars are not loaded to their full caapacity it is hardly worth while to build them larger, that is, the general run of cars, and until we can settle more definitely than seems to have been done here to-night, on that question, it seems to me it is not necessary to say so much about construction. So far as I have been able to think about the matter this evening, that seems to be the idea that suggests itself to me.

The PRESIDENT—Is there any one else present who would like to talk further on this subject.

A MEMBER—It was not my intention to participate in this discussion, being a new member, and not being familiar with this subject, but I am in the soliciting department of railroad work, and would like to advance one opinion. I think the question will greatly affect the traffic department, as we have minimum weights for many articles, and I think that this is a very material point in changing the limit of capacity of cars. So many cars take a minimum of 10, 12, 15 and machinery 20,000 pounds, where the length of the car is less than 30 feet, or 24,000 pounds when the measurement is over 30 feet in length, consequently the cost of hauling the car is little increased or decreased, and I would just like to present that thought to the meeting.

Mr. BRADLEY—I hope this Club will take strong ground, and will say to the traffic people that they must make their classification so that on these fragile and bulky articles the rate shall be per cubic foot without regard to weight. If the traffic people will make the tariffs on that

basis, you will hear no more about the question of cars larger than 60,000 pounds capacity.

Mr. MOLYNEUX—The Sound boats load the freight by weight and by measurement. The receiving clerk has a scales and a yard-stick, and he either weighs the freight or he measures it when they load the boat.

Mr. FOWLER—And if they find it will run up more on the weight, like pig iron, they weigh it, and if it will show more by measurement, they measure it. (Laughter.)

The PRESIDENT—I hope no member will miss the opportunity if he has anything to say. The subject is just beginning to warm up. Are there no traffic men, members of the Club, who have something to say on this subject?

Mr. FOSHAY—There is one more thought in connection with this question of traffic. Every day fast freight is becoming a matter for greater consideration, that is, freight that you want moved quickly from one point to another, perishable freight, and those loads are usually small, and there is no necessity for having too large a car in that case.

Mr WATTSON—I think the committee has covered this large car question so thoroughly that little is left to be said by we members. There seems to be rather a dearth of new ideas after this voluminous report, but I wish to say that the committee is to be heartily congratulated upon furnishing the New York Railroad Club with so able a report, which I know will be highly appreciated by the railroad men throughout this country.

This large car question, we notice by the committee's report, has been considered before, and has been a favorite subject for discussion in various associations and technical societies, but I think that our report is the first one to make a definite recommendation. There has been much talk about the queston, but no real recommendation. Before anything can be done or accomplished, in the way of making a rule, somebody must say what that rule shall be, and it is to the honor of this committee and the New York Railroad Club, if it approves the committee's report, to take a position on this large car question, and that is that the limit for box cars shall be placed at 60,000 pounds capacity. I think, further, that the chairman of the committee is entitled to the praise and thanks of this club for the work which he has done in inducing so large a number of prominent railroad men to put themselves on record, and to say something for the benefit of their brethren on the question. The impression has gone abroad that railroad men, as a general rule, are very reticent in public utterance, and dislike exceedingly to say anything on paper, and in this case we find that through some enchanting method our committee has been able to induce a large number of very prominent railroad men to express themselves freely. The reason for it must be that the subject is thought to be one of extraordinary importance.

In considering the question as a whole, it appears to me that the most important conclusion, that is, as a general one to the railroads, is that

there should be an agreement between all railroad companies as to the size and capacity of cars which shall be interchanged. There is no one thing in the operation of railroads which causes more trouble or loss of money than the variation in the carrying capacity of cars. And also, I think it is the means whereby some railroads treat others unfairly. For instance, a road that has twenty thousand 30,000-pounds capacity cars is interchanging business with a road that has twenty thousand 60,000-pounds capacity cars, I am satisfied that roads owning small capacity cars have systematically taken possession of the large capacity cars of their neighbors and did their local business in these cars and sent their small cars to their neighbors. It took some railroad companies a good while to find out that there was much more profit in a big car than a small car—that is, generally—but the roads that had the small cars found it out very early. Again, the large capacity car, operated with small cars, makes a great deal of trouble with the shippers, and through them with the traffic department. The shippers soon found out that there was some advantage in large cars, and wanted them, and as soon as the traffic department found out that the large car could be used as a factor in competition, they began to utilize the big cars, as soliciting agents, and so the trouble has increased. Again, we have demonstrated to our satisfaction that there is an economy and profit in operating large cars, that is, 60,000 pounds capacity, over the 30,000 and 40,000 pounds capacity. We haul 30 cars of 60,000 pounds capacity with one engine about as easily as we used to haul 30 cars of 40,000 pounds capacity. We do not now notice any difference. Our engineers, at first, rather objected, and said that they could not get over the road, and wanted to cut down the trains of 60,000-pounds cars, but we got the conductors to tell them that the big cars were all loaded with hay (Laughter), and they pulled them along about the same, and to-day we are hauling the same number in a train load as we used to haul of the small capacity cars. However, the large car introduced the idea of the "survival of the fittest" very forcibly. The small cars, handled with the big ones, soon get knocked out, and by this reason the cars of less than 60,000 pounds capacity are fast disappearing. Now, a 70,000 or 80,000-pounds capacity car will knock out the 60,000-pound car just as the 60,000 has knocked out the 40,000-pounds car. Therefore, aside from other considerations, I think cars of greater capacity than 60,000 pounds should be kept out of general interchange service for some years to come. From all these conclusions, I think the recommendations of the committee for a standard size car for general interchange is well founded.

C. E. GILL, Chairman Official Classification Committee (by letter)—I have read this publication with a great deal of interest, especially that portion which refers to the subject from the traffic standpoint.

Referring particularly to the statement of the committee, on page 8 of the publication, "that the simple and natural remedy for this would seem to be the establishment of a rate unit for light and bulky articles, that will make no distinction between the use of small and large capacity cars,"

and on page 9, "our committee is of the opinion that the basic factor of the sliding scale of minimum weights should be not the length of the cars, but their actual inside cubic capacity, and that in order to make this opinion of any practical value, it is necessary that all box cars have their cubic capacity stenciled on the sides in the same manner as their tonnage carrying capacity," and urging strongly that this be done and made effective by the passage of a resolution in the Master Car Builders' Association and the American Railway Association.

I desire to say, that while there can be no objection to the stenciling of the cubic capacity of box cars on the outside thereof, I am of the opinion that if this is done solely for the purpose or with the expectation that future classifications will be arranged upon a sliding scale basis, conforming to the cubical capacity of the car, it will entail an amount of work which is seemingly unnecessary, for the reason that it is doubtful if the classifications will ever be so arranged, and my reasons for such belief are as follows:

(1) The minimum carload weights in effect under the various existing classifications are, as a rule, based upon fair averages of the actual weights of the various articles that can be loaded in what may fairly be considered ordinary or standard sized cars, and the adjustment thereof is, in my opinion, more generally satisfactory than would be the case if rearranged upon any basis having for its object the equalization of the capacities of different sized cars, having due regard to the limited scale of rates in which changes in classes can be made, and waiving all other elements, factors, considerations and commercial conditions, and, at the same time, preserve the interests of the carriers and do justice to the shipping public.

(2) Under the proposed plan it would be necessary for agents and their assistants to ascertain and insert in the shipping receipts and way-bills the cubical capacity of cars loaded with articles subject to the varying minimum weights. With respect to cars loaded under the immediate supervision of employés, it is sufficient to suggest that these requirements would involve additional labor and expense and the exercise of greater diligence than heretofore requisite, without anticipating other difficulties not easily foreseen. But in the case of cars loaded on private sidings or at points distant from stations, it is obvious that the obstacles in the way of ensuring the proper billing according to the capacity of cars would not be readily overcome, and, in some instances, would perhaps necessitate the expenditure of more time and labor than justifiable or warranted.

(3) The plan would also entail additional clerical expense at stations and junction points, occasioned by computing charges according to the varying minimum weights and because of the necessity of entering upon way-bills and transfer slips the cubical capacity of cars, and in the checking of same.

The liability of error in way-billing would be increased, and mistakes

based upon the capacity of cars would be difficult of correction, either by agents or auditing officers.

(4) The establishment of varying minimum weights based on the cubical capacity of cars. would require of agents, particularly at large stations and terminals, a very complete knowledge of the capacity of all cars placed for loading carload traffic, and would impose additional burdens upon them in arranging to fill orders from shippers for cars of specific capacity. This would, in many cases, cause extra switching, and doubtless result in detention in the loading and unloading of other freight, and possibly complications with respect to demurrage charges. The practicability and expense of accomplishing these ends could be determined upon only by experience.

(5) The proposed plan would, in all probability, occasion vastly increased switching expenses, especially at large stations, car yards and terminals, in separating and supplying cars of varying capacity. At some points it might be found necessary to entirely reorganize methods of storing and handling cars, particularly where trackage room is limited.

It would also be incumbent upon trainmasters, superintendents and other operating officers to acquire and retain an extensive knowledge of the capacity of cars, in order to supply the demands for cars of specific dimensions, and to effect the most economical distribution of equipment according to capacity. This might, and doubtless would, necessitate a rearrangement of reports from agents and yardmasters of empty cars on hand, if not radical changes in established systems, the expense of which is not overestimated.

(6) It is presumed that shippers of articles subject to varying minimum weights, when ordering cars for loading, would be required to designate the capacity of the car desired, or in default of such notice, to accept the minimum weight attaching to the cars placed for loading. Obviously, this would result in friction and dissatisfaction if a car of greater dimensions than necessary were ordered or furnished. If it is to be considered that shippers cannot always predetermine the size of car required for loading a certain quantity of freight, especially articles varying in bulk or method of packing, it will be appreciated that this feature of the situation is not overestimated.

If such requirement were not insisted upon, agents would, in many cases, furnish two cars for a shipment where one larger car would be sufficient, resulting in the unnecessary hauling of a second car for the revenue derived from a small quantity of freight at actual weight and carload rate.

(7) In cases where articles subject to varying minimum weights would be loaded by carriers, in accordance with established usage, and a car of greater capacity than requisite were used, it is reasonable to assume that shippers would protest against the additional charges, based upon increased dimensions of car. In order to avoid contention from this cause, agents would have to possess very accurate knowledge of the loading of

different articles, or else two cars would be utilized and hauled for the revenue properly derivable from one.

(8) Recognizing that commercial usage has fixed the existing minimum carload weights as units of quantity in the quotation of prices and sale of various commodities, and that freight charges thereon are calculated accordingly, the conclusion is inevitable that the adoption of varying minimum weights would cause serious disturbance to commercial conditions and render indefinite and problematical what constitutes a carload. The results of such a radical change in established methods can hardly be predicted.

In giving consideration to this question at various special meetings of our Classification Committee, held during the year 1891, looking to a revision of the minimum carload weights of the Official Classification, so as to overcome the disparities complained of, and with a veiw to equalizing the varying capacities of cars, after an exhaustive discussion of the subject, the committee recommended, as in their judgment, the most effectual, satisfactory and lasting remedy for the difficulties of the situation, that limits be agreed upon and established as maximum dimensions for freight equipment, and it is my opinion that if this is arranged for on the basis suggested in your report, touching upon the standpoints of operation, construction, maintenance, and the increased cubical capacity of cars, that the traffic situation will accommodate itself to such equipment, without material changes in methods or conditions as at present existing in the various classifications in effect throughout the United States.

Mr. BLACKALL—I move that the sense of this Club is that no box car be built of a capacity over 60,000 pounds. Motion was seconded.

The PRESIDENT—Before that question is put, Mr. Wheatly has some suggestions in the way of a resolution to offer, and it seems to me we ought to embody them all in one resolution, so that the New York Railroad Club can go on record as recommending to the Master Car Builders or the American Railway Association, some definite figures, and I would also like to ask Mr. Wheatly, in arranging that resolution, to include Mr. Bradley's suggestion to our traffic managers in regard to the loads being gauged by their cubic dimensions. I think Mr. Blackall, Mr. Wheatly and Mr. Bradley could get this matter into the shape of a resolution.

Mr. BLACKALL—I withdraw my motion.

Mr. MITCHELL—After you offer a resolution like that, we will all go home and do as we please, won't we?

The PRESIDENT—Certainly.

Mr. MITCHELL—I would. If a certain line of freight originates on the Erie Railroad, and I am asked to design a car for it bigger than this, I will certainly do it.

The PRESIDENT—There is not a particle of doubt but that a car of 80,000 pounds capacity can be built, but is it policy to do it. If our lading

West is not one-half of what it is East, are we not losing money? There is a question of fuel and wear and tear that enters into that problem. It is not all gain we get hauling a loaded car East.

Mr. MITCHELL—My figures show that if you move a car East under full load, and West under only one-tenth load, you will make more money with the big car.

The PRESIDENT—The question is how big.

Mr. MITCHELL—The bigger, the more money. My figures show an increased net revenue of 46 cents per car mile of the 80,000-pounds car over the 60,000-pounds car. Now, if you make the car 100,000 pounds capacity, instead of 60,000 or 80,000, you make more money.

The PRESIDENT—It seems to me Mr. Foshay has also brought out a suggestion that has to be considered. That is, the movement of fast freight. There is no doubt that the railroads that are going to get the business are the ones that get their freight to destination quickest, and whether we can haul the 80,000-pounds capacity cars as fast as the 60,000-pounds car is a question.

Mr. FOWLER—I do not see why Mr. Mitchell's figures are not true of any cars. If you can raise your paying load to 80 per cent., I do not see why you cannot make more money by increasing the size of your car, and you can increase your capacity faster than the dead weight of the cars is increased. You might go up to 1,000 tons capacity, and as long as you can keep decreasing the dead weight per ton of paying load, as far as that feature of the question is concerned, you will make more money.

Mr. MITCHELL—You take the single hopper-bottom coal car that is in use to-day, 28 feet long, 8 feet 6 inches wide, and 4 feet high—the body—it carries, on an average, about 40,000 pounds of coal. I weighed 125 of those cars, taking ours together with the D. & H., and the Pennsylvania Coal Company, and others coming to us with supply coal, and I got the average weight for the cubic foot of 53 pounds, and I find that almost a majority of the cars running East carry 40,000 to 45,000 pounds of coal. Taking those cars on the Ship Canal Dock in Buffalo, the stevedore would unload them for 20 cents—after they were dumped the shoveling had to be done, for which their charge was 20 cents per ton. I wanted to carry 60,000 pounds to the car instead of 40,000, and I designed a twin hopper coal car, using the basis of 53 pounds per cubic foot of coal. We have had in that car 66,000 pounds of anthracite and 62,000 pounds bituminous slack. We put that car on the coal dock at Buffalo, and the stevedores unloaded it at the same price as the 40,000-pounds car. The amount for shoveling was the same in both cases, but in one case there was 1,350 pounds dead weight, and in the other case 950 pounds dead weight for every ton of paying freight. Therefore I reduced my dead weight 400 pounds per net ton of paying freight, and I am hauling one-third more load East, 60,000 pounds instead of 40,000 pounds, so that I am saving very materially in the return load and in the dead weight. Now, if I built a car of 80.000 pounds capacity instead of 60,000, I would still further decrease my dead

weight per paying load. That is the question for us to consider, for if our railroad bridges will carry this weight, the time may come when we will not want this resolution staring us in the face.

Mr. TRATMAN—A superintendent was in my office to-day, and I asked him what he thought of the large car question. He said he had about a dozen big cars built for light local freight, and they were a great nuisance. Every shipper who has ever had one wants it a second time. He says he does not want any wrecks on his road, but if he should have any he would like to see those cars in them.

The PRESIDENT—The question is whether the shippers are not getting more benefit out of the large cars than the railroads are.

Mr. WHEATLY—The resolution has been prepared, and reads as follows:

"Resolved, That it is the sense of the New York Railroad Club, on the question of large capacity cars for general interchange service, that box and stock cars shall not be built to exceed a capacity of 60,000 pounds, and that this Club earnestly recommends to the traffic associations that in making their rates on light bulky freight such rates shall be based on the cubic capacity of the car."

Mr. MITCHELL—Why limit it to light bulky freight?

Mr WHEATLY—Because on heavy freight you can always get the weight into the car, and the classification does not provide any scale of minimum weights for heavy freight. It is only on light bulky freight that the classifications have certain minimum weights that shall be charged for.

The PRESIDENT—Is that resolution seconded?

Mr. BLACKALL—I second it.

The PRESIDENT—You have heard the resolution, gentlemen. Is there anything to be said on it before we vote? If not, as many as are in favor of it will manifest the same by standing. Opposed, by the same. The resolution is carried. If there is nothing else to offer under this head, we will call it closed and pass to the next order of business, the election of new members. The secretary will read the names.

The Secretary read the names of forty-six gentlemen proposed for membership, as follows: Rufus L. MacDuffie, S. M. Miller, O. D. Pratt, A. J. Pitkin, George Place, A. E. Ruffer, Chas. W. Reinoehl, W. R. Sattler, W. H. Steele, Benj. F. Shakespeare, Chas. N. Finch, L. D. Fouquet, Geo. H. Oliver, F. N. Hibbitt, Wm. A. Higham, J. W. Holloway, Rufus Hill, Francis LaBau, S. H. Lissner, T. W. B. Middleton, W. McMahon, W. A. Stadelman, Chas. S. Mott, Fred. H. Eaton, Henry W. Avery, W. M. Armstrong, T. R. Browne, Robert Brock, W. N. Bannard, I. W. Couch, A. J. Clifton, Fred. H. Bates, B. E. Decair, David R. Daly, J. E. Saque, Seaton M. Scott, E. H. Talbott, Frank Tuma, W. W. Turlay, W. H. Tuthill, Percy R. Todd, H. E. Williams, Geo. H. Waters, C. E. Douglass, Joseph M. Barker.

The PRESIDENT—What is your pleasure, gentlemen? I think we

should all be highly gratified at the names read over. Among them are those of some strong men in the railroad world.

Mr. MITCHELL—I notice among the names read are those of two students of the Stevens Institute. I wish the President would extend an invitation through them to the students of the institute. They are likely to make valuable members of this club.

The President here extended an invitation through these two gentlemen to other students of Stevens Institute to join the club.

On motion the secretary was directed to cast a deciding ballot, making these forty-six persons named members of the New York Railroad Club.

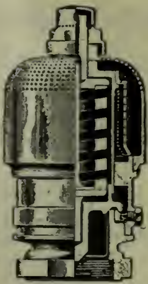
The SECRETARY—The ballot is cast.

The PRESIDENT—The next is Announcements. Under this head I think that the club should give a vote of thanks to the committee for the splendid report we have. It is a compliment to the committee that so strong a body of men have placed themselves on record in this matter, and I think the committee are entitled to a great deal of credit for the way in which they have handled this matter.

Mr. MITCHELL—I think the committee deserve a vote of thanks, and I move that this club extend to this committee a vote of hearty thanks. The motion was duly seconded and carried by unanimous vote.

The PRESIDENT—The secretary announces that he is ready to receive dues which are now due for the year 1896.

On motion adjourned. Refreshments were served as usual.



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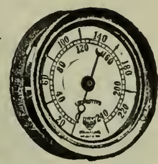

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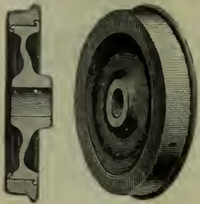

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Meeting of March 19, 1896.

New York Railroad Club

MEMORIAL MEETING.

Published by the Club.
W. W. WHEATLY, SECRETARY, FOOT WEST 42D ST., NEW YORK.

New York Railroad Club.

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Supt. of Motive Power, N. Y, O & W. Ry.

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Supt. of Motive Power, N. Y., L E. & W.

Second Vice-President,
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H. W. Johns Manufacturing Co.
D. M. BRADY,
Brady Metal Company.

PROCEEDINGS

of the Meeting held at the Rooms of the American Society of Mechanical Engineers, 12 West Thirty-first Street, New York, on Thursday Evening, March 19, 1896.

Meeting called to order 8:20 P. M. President West in the Chair. Members present, 125.

On motion, duly seconded, the roll-call was dispensed with.

The Secretary read the minutes of the last meeting, which were approved as read.

There were no reports of committees, and no unfinished business.

The PRESIDENT—The next in order is new business.

Mr MITCHELL—Mr. President, under the subject of new business, I think we had better appoint a Committee on Resolutions,

to draft resolutions relating to the death of our late Secretary; and I make the motion, if it is in order, that the President appoint a committee to draft resolutions, with power to act, to have those resolutions engrossed, and that they be authorized to draw upon the Treasurer for whatever amount is necessary to engross the resolutions, have them framed in good style and delivered to the family of the deceased.

The motion was seconded.

The PRESIDENT—You have heard the motion, gentlemen. Are you ready for the question?

Motion was put and carried by unanimous vote.

The PRESIDENT—At the meeting of the Executive Committee this afternoon, it was suggested and recommended by that committee and the other officers of the club, that we dispense with the regular order of business to-night; and that we have a sort of memorial meeting, and offer a memorial tribute to our lamented Secretary, W. G. Wattson. A dear friend of mine several years ago, in parting, said to me: "In ascending the hill of prosperity, may you never meet a friend!" Gentlemen, we have all lost a friend. The New York Railroad Club has lost a valuable and progressive officer; the West Shore Railroad has lost an efficient, conscientious Superintendent; a fond wife has been prostrated with grief, and three loving children have had their hopes blasted in the death of our lamented Secretary, W. G. Wattson. We are here to-night to express our sympathy for the family in this their time of sorrow and affliction, and to tell the world how much we loved him. It has been said that human sympathy availeth but little in times of deep distress and sorrow. If indications prove anything, the expression of love shown at his funeral on Friday last would show that he was loved by the rank and file as well as the officials of the great system which he represented, for in all my life I never saw such emblems of "peace on earth, good-will to men" as was shown this officer. I wish I were capable of expressing my admiration of the man. He was a man who dared to do right, and this fair land of ours has not many men of that stamp, and it can ill afford to lose him. As many of you know, the railroad I represent has a traffic contract over a portion of the line which was under the supervision of Mr. Wattson, and I have

been brought into close business relations with him, and I have always found him a man of honor and justice in dealing with employés. I will leave it with you, gentlemen of the New York Railroad Club, to say as to how we shall best express our sympathy and admiration for such a man as was W. G. Wattson. Mr. Mitchell, is it your wish that the committee be appointed now?

Mr. MITCHELL—Yes, I think so.

The PRESIDENT—I will appoint as the committee, Mr. C. W. Bradley as Chairman, and the members of the Executive Committee as co-operators with him in having those resolutions drawn up, engrossed and having them presented to the family and a copy to the club.

Mr. MITCHELL—Mr. Bradley, the General Superintendent of the West Shore Road, very kindly gave a train to the members of the New York Railroad Club, to attend Mr. Wattson's funeral. We may wish to extend a vote of thanks for that train and for the courtesies extended. I therefore make a motion that the thanks of this club be extended to Mr. Bradley and the West Shore Railroad for the courtesies extended.

The motion was seconded and adopted by unanimous vote.

The PRESIDENT—The meeting is now open to any one who feels like saying a word. I know there are a great many present who will want to say something.

Mr. COOLBAUGH—I see Mr. Bradley is here to-night. I would like very much to hear Mr. Bradley say something.

Mr. BRADLEY—Mr. President, if I should say all that my heart feels I would detain you here until morning. Probably one of the saddest weeks of my life was the week after Mr. Wattson was shot in his office at Weehawken. I was with him most of the time until his death. I perhaps knew Mr. Wattson as intimately as any person present. He has been associated with me since 1883—thirteen years. There never was a more loyal, faithful and able assistant for any man on earth than Mr. Wattson has been to me. He was a good citizen and a manly man in every sense of the word; a Christian gentleman, loyal to every trust, loyal to his family, to his God and his friends. When I think of his poor wife and his three lovely children, my feelings overcome me. You will excuse me if I do not say more. I would if I

could. You may call upon me for any assistance it is possible for me to render you in any tribute to his memory.

Mr. COOLBAUGH—I think one of the handsomest tributes that could be paid to the memory of Mr. Wattson has just been given by Mr. Bradley. No man in the world, no man among all his acquaintances, has known him so intimately as he, and the tribute he pays to him for efficiency and loyalty is certainly one we ought, as a club, to appreciate. One of the other tributes I was impressed with at his funeral was this: Railroad men came a distance of over four hundred miles to pay tribute to Mr. Wattson by attending his funeral—men who had known him, not in the last fifteen or twenty years of his life, but whose recollection of him dated back twenty-five years, showing that even at that time his character had impressed itself upon those with whom he associated early in life; and to have attended that funeral, as many of us did, and seen the hundreds of people that came there, and the tributes in the shape of flowers, was certainly a most impressive scene. His taking-off is one that makes us feel, as we do to-night, sad, indeed. To me it seems such an unjustifiable, such an unaccountable thing—a man like Mr. Wattson, who has been known all the years of his life for his consideration for others' feelings, not an aggressive man, not a man to antagonize. It seems to me, as I expressed it to a friend, like a man stepping out of this room, with a revolver in hand, and shooting down a child on the street. This seemed to express to me the murder of Mr. Wattson. The place he held in the minds of the members of this club, I know, is a very warm one, and his memory will be a pleasant one always to us.

Mr. A. D. SMITH—I wish to say, as an employé of the West Shore Railroad at Weehawken, I was often brought in contact with Mr. Wattson, and had an opportunity to know him very well. He was one of those kind of men that the better we know them the more we admire them. I know that I express the sentiment of every employé of the Hudson River division when I say we have lost a wise counselor and a true friend—one whom we all have learned to respect, not only for his integrity as an officer, but as a Christian gentleman.

Mr. J. A. GORDY—I cannot think of Mr. Wattson as an em-

ployer, or head of our department in the West Shore service, without combining the thought that he was also a sincere friend to all who did their duty. He was devoted to the company's interests, and at the same time patiently heard and weighed every point before rendering a decision against any one. It always seemed to me he had an acute, analytical mind, and was possessed of the keenest discernment. He could quickly determine the merits of a case, but was never quick to express himself. Above all else, I respected Mr. Wattson for his fairness and just treatment under all circumstances. I believe he would, if need be, incline toward the side of a man in whom he was not specially interested, rather than allow himself to become prejudiced in favor of one more in sympathy with him. Speaking personally, he was to me more as a brother than a superior officer.

Mr. WHEATLY—It is not my purpose to pronounce any extended eulogy upon the character, life and services of the friend whose untimely death we so profoundly regret. William Grafton Wattson, at the full meridian of his intellectual powers, with many years of usefulness and worldly honors before him, at a time when more than ever he was needed by his family and his friends, has reached his journey's end. He fairly earned the responsible position he held in the service of the company by which he was employed, and he deserved the friendship and the esteem of his associates and fellow employés. His intellectual attainments commanded our admiration, but his character commanded our respect. He did his part honestly and honorably and to the best of his ability. He was true, just, honest and faithful. He did well his duty in that sphere in which Providence had placed him. His distinguishing characteristic was his perseverance, his courage. With him, disappointment or defeat was but a spur to further effort. He had energy of will, self-originating force and self-reliance. When he was stricken down by an assassin's hand, although he fought a losing battle from the moment of his injury, his heart remained undaunted, his courage never faltered through all his bitter suffering. Unshrinkingly he fell into the last sleep, and we may hope that its waking was one of joy. (Applause.)

Mr. SINCLAIR—There are times and circumstances when language fails to express what people feel towards those who are

gone. A meeting of this sort is, to a great extent, like the meeting was that a great many of us attended the other day when we saw the last of Mr. Wattson. We went there to pay the last tribute of respect to a man whom we held in the highest esteem. We come here to do something of the same kind ; but it is very hard finding words to express our feelings in a way that would do justice to what we want to express. I think that the mere presence of so many here to condole on the loss we have sustained is the best testimony that we could expect from the club. It is the largest meeting of the club that I have ever attended, and therefore it seems to be a supreme testimony to the respect which we all feel for the officer whom we have lost.

Mr. MITCHELL — Although not well acquainted with Mr. Wattson socially, I have been intimately associated with him for the last two or three years in the work of the officers of this club. I have been with him on the Executive Committee ; I know what his work has been, and I wish to state that I learned to admire the man very much. As an officer of this association, I have never seen a man who would put so much into his work as he did and make such a grand success of his office.

Mr. ALDCORN—I just want to say one or two words. I entered the service of the West Shore road about the same time Mr. Wattson did, and remained in it until 1892. From the time he entered the service until the day he was promoted to be Superintendent of that road, I can say that Mr. Wattson never did a man on the road a wrong. With any case that came before him he was very deliberate, and weighed all the facts before he decided. One thing I can say is, that the man who committed the deed did not have a better friend than Mr. Wattson. I know what Mr. Wattson had to put up with, with that man, and I say, that if ever there was a dastardly deed done, it was done to Mr. Wattson.

Mr. PARKE—Mr. Chairman, there are several members of this club who were doubtless much better acquainted with Mr. Wattson than I was. I think that I knew Mr. Wattson well enough, however, to enable me to appreciate many of his qualities in a way and to a degree that caused me to feel an unusual interest in him. In expressing my sorrow for his untimely end, it is difficult for me to express myself as I would like, because of conflicting

feelings which it is hard to smother. One of the most heartfelt sentiments which prevails with me is one of keen disappointment, and another is one of bitter resentment. While I fully appreciated those excellent qualities that always made Mr. Wattson attractive, I always felt inclined to think of him in the light of the future which I fully believed lay before him. He seemed to me to be a man of unusually keen observation. In making use of his powers of observation, he not only acted promptly and energetically, but this energy was tireless and accompanied by a persistence and pertinacity of purpose that inevitably brings forth fruits. Above all, he was controlled throughout by an unusual intelligence. His observations were thoughtfully considered; the course that he energetically inaugurated and persistently maintained was guided by an alert intelligence, and in the end achieved worthy results. These characteristics are not merely the foundations of success, but they are the elements of greatness. It was thus that I always looked forward to the future which I believed the man had before him. Nothing more cruel, in my eyes, could have happened to poor Wattson than to be cut short in his career in such a brutal way. Had he sickened and died, we should have been indeed sad; but that he should be cut down in so ruthless a manner is not only lamentable, but it is intolerable. When hope of his recovery was obliterated by the knowledge that the cowardly attack upon him had terminated fatally, there arose within me a spirit of hot resentment which I cannot yet shake off. During the spring of 1886 I was engaged in Chicago, and well remember the tightly drawn lips and stern faces of those I met on the morning after the Haymarket riot, in which a number of innocent men were slain by the bomb of the anarchist. I felt then, and I have known since, that one resolute leader could have easily led a thousand armed men before the Cook County Jail to deal summarily with those who instigated the brutal deed. It was something of the same feeling that came back to me upon the day that I learned that the blameless and useful life of Mr. Wattson had succumbed to the unprovoked attack of a man, instinct with brutality, whose own usefulness had been destroyed by debauchery. Far be it from me to encourage lawlessness; but there are times when it is refreshing to see the people rise in their

wrath, as they did in New Orleans after the dastardly murder of the Chief of Police, and say: "This is intolerable; we will deal with it summarily."

Mr. RAUCH—I would like to follow up for a few moments just what the gentleman has said who sat down just now. Cannot this club in some way take action or do something to insure the conviction of this man? Is there any way we could aid in convicting him? Fortunately, it happened in New Jersey, and we know they have a different way of dealing with such things over there than they do in New York; but I would like to know whether we cannot make some expression or take some action that would help to secure Clifford's conviction and his execution?

Mr. BRADLEY—I think it would be unwise to make any formal demonstration on the lines which the gentleman who has just spoken indicated. I think that we can safely trust the authorities of the State of New Jersey to see that ample justice is done in this case. Any pressure that might be brought on our part would re-act; and from what I know of the manner in which justice is dealt out in the State of New Jersey, I know that we may safely leave the assassin in their hands, feeling that justice will be done. Any formal action we might take would not be wise at this time.

Mr. VREELAND—At such time and under such circumstances, no matter what control a man has of language, thoughts fail him. I have known Mr. Wattson quite intimately, both in business and in the Railroad Association of Superintendents, and in this club, since he was first appointed Superintendent of the West Shore road. I was drawn to him as one of our coming bright railroad men, when I first heard him address the American Association of Railroad Superintendents on topics that were before them, at their first annual meeting after Mr. Wattson was made Superintendent of the West Shore. In my work, with the large interests around the country which I represent, it is necessary for me to carefully study railroad men. The necessity frequently arises for me quickly to pick out the right man for the right place. I have carefully studied Mr. Wattson's railroad work and his work in this club. I can join with Mr. Mitchell in saying, as a member of the Executive Committee, during my term of office (Mr. Watt-

son was on the same committee), that the energy and clear-headed judgment which he brought to bear on the many questions which came before the Executive Committee were of great value in their deliberations. When the question of a successor to the Secretary of the year previous came up last fall, I, in considering the various members of the club that were eligible to the Secretaryship, appreciated that it was as important an office for the good of the club and the advancement of its interests as was any of the various offices represented—more so, in fact. I thought of Mr. Wattson, and at the first opportunity spoke of him. On the day on which the Executive Committee met and appointed Mr. Wattson as Secretary, I raised the only question that was raised. I said then that it had occurred to me that a man representing the interest he did—the amount of work he had, the detail he had upon him, the knowledge of which came to me from having occupied a similar position with other companies—might not have time to attend to the duties of this position. I said : "I want Mr. Wattson to say whether he could give the time necessary to the important work of this club." You recall, as I do, his answer : "It is the busy man that can fill a position of that kind. The man who is not busy, who is not an active worker, who is left to his own thoughts, does not have time ;" and this was pertinent and so characteristic of the man, and so suggestive of his value to the club, that I immediately asked for a unanimous vote for his appointment. What his services have been as Secretary, we of the club know ; and without detracting one iota from the services of past Secretaries, we know that Mr. Wattson brought to this work all the energy, all the quickness of intuition that has characterized his business life. His attendance on all the meetings of the various committees has been regular, and he has shown an activity and energy in everything he took hold of in connection with the work of the club. I feel personally, and officially as an officer of this club, that I have sustained a serious loss. As to his associates in business, his family, etc., it does not behoove me to speak. Those associated with him, those who knew his family better than I, can better express those sentiments. I was very busy at the time of Mr. Wattson's funeral ; but I was willing to lay down all business for the day and give it to a memorial

tribute of respect to his memory, to offer my presence with the other members of our club who attended, as a token of respect and regard that this club had for their lamented Secretary.

A MEMBER—Mr. President there is a gentleman here who knew Mr. Wattson intimately—Mr. Stewart.

Mr. STEWART—I had not intended to say anything to-night. I was very closely connected with Mr. Wattson, both in business relations and friendly relations; in fact, I think I can say that I knew him well. I cannot speak about him without showing my feelings too strongly, and I beg that you will excuse me.

Mr. DIXON—As Chairman of the Finance Committee, I would like to say to the club that the income of this club has been increased a good deal over 50 per cent., the greater part of which was secured through the hard work and industry of Mr. Wattson within the three months he has occupied that position.

Mr. MENDENHALL—For a body of men, accustomed as we are, to attending meetings of this nature, and expecting them to be conducted by members of a profession whose duties are in this line, it is a very fitting tribute to Mr. Wattson's memory for us to have devoted the evening as we have. If there are none others who care to speak, it seems to me that we might, by closing before the proceedings are long drawn out, add to the tribute which we have started—if I may use that word—thereby making it even more impresssive; and if there are no others who wish to speak, I would move that we now adjourn.

The PRESIDENT—Before the vote is taken, I have a communication from the Central Railway Club of Buffalo. I wrote the Secretary notifying him of Mr. Wattson's death, and in reply he says: "The Central Railway Club has learned of the sad loss sustained by your organization, in the untimely death of your Secretary, Mr. W. G. Wattson, and begs to extend to the members thereof its most sincere sympathy." I have also received the following communication from the New England Railroad Club: "By a unanimous vote of the New England Railroad Club, at its meeting on March 10th, 1896, we were directed to convey to our sister club of New York our sincere regrets at the sad and untimely removal, by death, of your most efficient Secretary, Mr. W. G. Wattson. Those of our members who were honored by a

personal acquaintance will remember with pleasure his pleasant, kind and generous characteristics; others who have listened to his cheerful yet forceful and logical remarks, as well as all those within the wide range of the literature of your association, will agree that his mission on earth was not in vain, and that the world is richer by his abode therein.''

The motion to adjourn was seconded.

The President—It is moved that, out of respect to the memory of our late lamented Secretary, we now adjourn.

The motion was adopted by a unanimous vote.

Adjourned at 9:40 P. M.

For report of Special Committee, see page 13.

Report of the Special Committee.

Resolutions of the New York Railroad Club,

March, 1896.

Whereas, The members of the New York Railroad Club have learned with deep sorrow and profound regret of the untimely death of William G. Wattson, late Secretary; and

Whereas, His long service as an active, useful member, and recently as the Secretary of this Club; his high intellectual attainments, his integrity of character and his successful achievements as a railroad officer merit a marked expression of the esteem in which he was held by his fellow members; therefore, be it

Resolved, That while we bow with submission to the will of Providence, we beseech Him that our great loss may be sanctified to our good, and that we may strive to emulate the prudent and Christian example afforded by the life and daily walk of

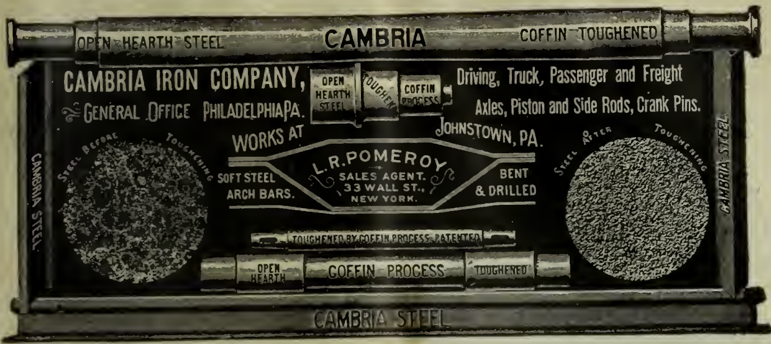
William Grafton Wattson.

Resolved, That we tender to the family of our deceased Secretary our sincere and heartfelt sympathy, assuring them that we mourn with them and that their grief is our grief; their loss our loss.

Resolved, That the Secretary be instructed to spread these resolutions upon the records of the Club, and to send a suitably engrossed copy to the bereaved wife.

GEO. W. WEST,
A. E. MITCHELL,
H. H. VREELAND,
C. M. MENDENHALL, Committee.
C. A. SMITH,
W. W. SNOW,
W. C. ENNIS,
SAMUEL HIGGINS,

C. W. BRADLEY,
Chairman.



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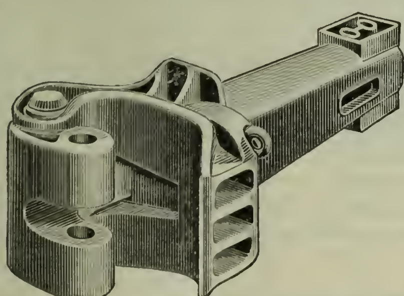

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MEETING OF APRIL 16, 1896.

New York Railroad Club.

Subject: How Can Our Station Service be Improved?

PUBLISHED BY THE CLUB.

W. W. WHEATLY, SECRETARY, FOOT WEST 42D ST,, NEW YORK.

New York Railroad Club.

OFFICERS FOR 1896.

President,
GEORGE W. WEST,
Supt. of Motive Power, N. Y., O. & W. Ry.

First Vice-President,
A. E. MITCHELL,
Supt. of Motive Power, Erie Railroad.

Second Vice-President,
H. H. VREELAND,
President Metropolitan Street Ry. Co.

Third Vice-President,
C. M. MENDENHALL,
Supt. of M. P., Pa. Wil. & Balto. R.R.

Secretary,
W. W. WHEATLY,
Car Accountant, West Shore R.R.

Treasurer.
C. A. SMITH,
Master Car Builder, Union Tank Line.

Executive Members,
W. W. SNOW,
President, Ramapo Iron Works.
W. C. ENNIS,
Master Mechanic, N. Y., Susq. & West.
SAMUEL HIGGINS,
Supt. of Motive Power, Lehigh Valley R.R.

Finance Committee,
R. M. DIXON,
Engineer, Safety Car Heat. & Light. Co.
F. M. PATRICK,
H. W. Johns Manufacturing Co.
D. M. BRADY,
President, Brady Metal Company.

PROCEEDINGS

of the Meeting held at the Rooms of the American Society of Mechanical Engineers, 12 West Thirty-first Street, New York, on Thursday Evening, April 16, 1896.

Meeting called to order at 8:20 P.M. President West in the Chair.

On motion, the roll-call was dispensed with. There were 108 members present.

The PRESIDENT—It has been suggested by our Secretary that the club have a boy with some printed cards at the door to hand to each of the members for them to sign on entering the club. I notice in the proceedings of the Western Club that the names of members present are printed in their proceedings every month. I may say that I have always been in favor of the roll-call, but until this suggestion of Mr. Wheatly's I have never been able to suggest any remedy to overcome the tedious task of running through the large number of names; and yet it seems due to those that are present that they should be recognized in some way in our proceedings. I think the suggestions of the Secretary are good,

and if someone will make such a motion we will try to have it put through.

A MEMBER—I think it would simplify matters if we were to have a register which each member should sign on entering the club.

The PRESIDENT—I think the experience of all the clubs has been, and that of every large body of this kind, that the members will not sign a register book; but if there is a card, and someone there to call their attention to it, they will fill it out.

Mr. BERG—A number of associations have adopted cards and find it better. I move that the suggestion of the Secretary with regard to the cards be adopted.

The motion was duly seconded and adopted by the meeting.

The Secretary then read the minutes of the previous meeting, which were approved as read.

Under the heads of "Reports of Committees" and "Unfinished Business," there was nothing to be considered.

The PRESIDENT—The next in order is "New Business." I understand Mr. Chamberlain, of the New England Railroad Club, is here, prepared to offer some resolutions of respect to the memory of our late Secretary.

Mr. CHAMBERLAIN (Boston & Maine Railroad)—Mr. President, what I wish to bring up relates to the death of the late Secretary of your Club, Mr. Wattson. You are, of course, aware of the friendly, fraternal feelings that exist between the New England Club and the New York Club, and immediately upon hearing of the death of Mr. Wattson we promptly forwarded to this club a set of resolutions extending our sympathy; and about that time we also caused to be sent to the widow of Mr. Wattson a memorial consisting of a book written over in probably six or seven pages. Furthermore, the New England Railroad Club thought likely that the New York Club would appreciate a more permanent set of resolutions, and they have therefore gotten some up; and I would say, Mr. President, on behalf of the New England Railroad Club, that we desire to present you with this testimonial of respect to Mr. Wattson.

The PRESIDENT—Thank you, Mr. Chamberlain—I think we had better have about five minutes recess for the members to examine and approve of these resolutions.

A recess was then taken.

The PRESIDENT—Mr. Chamberlain, on behalf of the New York Railroad Club, I desire to extend to the members of the New England Club, and to its officers, a vote of thanks, and to express our appreciation of their good-will, as shown in the testimonial they have forwarded to us in respect to our late Secretary.

We have several communications that should be brought up under the head of "New Business"—one from Mr. Pulaski Leeds, of the Lousiville & Nashville Railroad, which I will ask the Secretary to read.

The Secretary read the following letter:

Louisville, Ky., February 14, 1896.

Mr. George W. West,
President, New York Railroad Club,
Middletown, N. Y.:

Dear Sir—One of the greatest needs of the South and Southwest is a uniform and easily understood set of rules governing the loading of lumber and timber. The present rules as given under M. C. B. recommended practice are not full or explicit enough, and I wish that you would bring before your club the matter of formulating a full set of rules and present them to the next meeting of the M. C. B. Association for immediate adoption, as I think the necessity not only exists with us of the South, but it must be that other sections of the country are really in need of such rules. While I can give no new ideas in regard to this matter, at the same time I herewith hand you a set of rules as I have recommended for adoption by this company and which will be pretty universally adopted throughout the South and Southwest, it being a collection of the best methods already in practice of which I have any knowledge, and a description given to the best of my ability to cover the same, so that millmen and inspectors should not be at a loss as to their meaning. I send you blue print of a strain sheet on which I have based the different loadings, in which you will see that I have avoided the overloading of any one truck, and at the same time have loaded the cars as full as possible with due regard to safety.

Yours truly,

P. Leeds,
S. M.

The PRESIDENT—That letter reached me too late to be presented to the February meeting, and, as you all know, the March meeting was devoted entirely to the memorial service of respect to our late Secretary. I had the matter up before the Executive Committtee, which instructed me to write to Mr. Leeds that the matter should be referred to the Committee on Standards, of which Mr. R. H. Soule, Superintendent of Motive Power of the Norfolk & Western, is Chairman, and I wrote Mr. Leeds as requested. You will now hear the reply which Mr. Leeds has written to my letter.

The Secretary read a second letter from Mr. Leeds, as follows:

Louisville, Ky., April 3, 1896.

Mr. Geo. W. West,
S. M. P., N. Y., O. & W. Ry.,
Middletown, N. Y.:

Dear Sir—Yours of March 26th, relative to rules governing the loading of lumber and timber on open cars.

You understand that this was forwarded to you simply as a nucleus on which I was in hopes a committee would be appointed to recommend a

standard set of rules, as I consider every car builder in the country equally interested with myself in this matter.

Yours truly,

P. LEEDS,
S. M.

The PRESIDENT—Now, then, gentlemen, what is your pleasure regarding these letters? The matter is before you.

Mr. MENDENHALL (Pennsylvania Railroad)—Do I understand, Mr. President, that you have communicated with Mr. Soule with regard to Mr. Leeds' letter?

The PRESIDENT—No; I wrote Mr. Leeds, as suggested by the Executive Committee at their meeting referred to.

Mr. MENDENHALL—In view of the fact that we are so short of time now before the Convention, and that it will be necessary to refer this to the Committee on Standards, which will in turn report to the Executive Committee of the Master Car-Builders' Association, I would recommend that the matter be referred to the Committee on Standards, as suggested by the Executive Committee of the New York Railroad Club.

The motion was seconded and adopted.

The PRESIDENT—Mr. Berg has a matter he would like to present under this heading.

Mr. BERG (Lehigh Valley Railroad)—I desire to offer the following set of resolutions to this meeting:

"Whereas, Most comprehensive and valuable investigations into the properties of wood and tests of the strength of our commercial timbers have been carried on for a number of years in the Forestry Division of the United States Department of Agriculture, but have proceeded very slowly, and have from time to time been entirely discontinued on account of deficient appropriations; and

"Whereas, These investigations, as far as the results have been published, have already demonstrated that this work is tending towards a most needful and rational economy of our forest resources and desirable improvements in their use, resulting not only in a great saving to users of timber throughout the country, but especially offering a valuable guarantee for the proper safety of timber structures; and

"Whereas, It is desirable to emphasize not only the value of these government timber tests to the Engineering profession and to all technical and industrial interests, but also the importance of publishing the results of tests as promptly as possible; therefore,

"Be it Resolved, That it is the sense of this meeting of the New York Railroad Club, that our representatives in Congress be requested to make liberal appropriations from time to time for the continuance and more rapid advance of this work; and

"Resolved, Further, That these resolutions be regularly transmitted to the President of the Senate, the Speaker of the House of Representatives, the Secretary of Agriculture, the Chairman of the Committee on Forestry and Agriculture of the Senate, and the Chairman of the Committee on Agriculture of the House of Representatives.

"New York, N. Y., April 16th, 1896."

I would say in explanation of these resolutions, if I am in order, that it should need no force of argument to explain to railroad men the great value of our having an absolute knowledge of the strength of our principal structural American timbers, not only on account of the great use of timber for all structures of railroads, but also in the rolling stock of a road. That, further, it is certainly correct to say that we have very little reliable, authentic information on this subject, and therefore it is perfectly proper that this club should take action and endeavor to aid in the movement to further the series of tests that are being conducted with this aim in view. The status of these valuable Government tests at present is such that about 40,000 tests have been made of the different classes of timber, and more especially of Southern yellow pine; and with the exception of about 2,100, which were published in a special bulletin in 1893, the results of this enormous mass of tests cannot be published, although practically ready for publication, owing to insufficient appropriations. This resolution is in the nature of a request to the Government officials to give attention to this matter, and enable the speedy publication of this exceedingly valuable and large series of tests. I will read a few extracts from a communication I received a little over a month ago from the Chief of the Forestry Division of the Department of Agriculture, illustrating the points I have just made:

"The total number of tests made at the Mechanical Laboratory to January 31st was 39,437, which during February will be brought up to about 41,500, when all the material collected will be tested and the work for the present abandoned under the orders of the Secretary of Agriculture.

"The material for these tests was specially collected in the woods, comprising 356 trees, representing 32 species mainly of Southern growth.

"Of these sticks only a portion on Longleaf pine was compiled and worked up in Bulletin 8. There are, however, now the entire data on Southern pine worked up in manuscript. The average results will presently be stated in an eight-page circular, the status of the printing fund of the department preventing for the present the issue of a full bulletin. There will then still remain nearly as many data referring to other species undigested.

"You will, however, understand that this test work differs from other testing done hitherto, in that it places reliance only on large numbers. Hence, for instance, the 276 tests on Oregon fir would hardly warrant us in drawing any conclusions; they are not better than any other tests,

except that their moisture condition is noted, which is, to be sure, one important advantage.

"On the other hand, for the Southern pines we may claim to have such a series of data as to make it unnecessary for anybody else to test these timbers again; they cover such a large number, under all sorts of conditions, that absolute confidence in the reliability of the data for the range of strength in the species should be accorded them.

"But the mere establishment of the strength values does not exhaust the usefulness of these data; they were to be used, and will be used, if we are permitted, to establish such relationships as will lead to the formulation of rules of inspection—the most important object of these investigations—as a result of which the engineer or other consumer will be enabled to judge of the comparative value of the piece in hand.

"At present the work will be abandoned for the fiscal year, the allotment of funds having been exhausted, about $40,000 in all having been spent so far. An attempt to work up the test results, at least for data of strength, will be made.

"In the reading of the appropriations for this Division for the next year, the reference to this line of work has been left out and a discontinuance is probably contemplated. A bill making special appropriation for its continuance has been introduced in the Senate (S. 1214), but its passage is exceedingly questionable."

I would further state, to indicate that the adoption of this resolution by this club will not place us in an isolated position in this matter, that the attention of a large number of professional gentlemen and technical clubs throughout the country has been directed to this work; and resolutions similar to those just read, or covering the same thing, have been adopted by the Association of Railroad Superintendents of Bridges and Buildings, the American Society of Engineers, the Central Railway Club, Buffalo, N. Y.; the Western Railway Club, Chicago, Ill.; the Technical Society of the Pacific Coast, San Francisco, Cal.; the Engineers Club of Philadelphia; the American Institute of Architects; together with others of which I have not got the detail data. I move, Mr. President, the adoption of this resolution.

The motion was duly seconded and adopted by the meeting.

The PRESIDENT—The Secretary will now read a communication we have from the Northwestern Railway Club.

The Secretary read the following:

Minneapolis, February 17th, 1896.

Mr. W. G. Wattson,

Secretary, New York Railroad Club,

Weehawken, N. J.:

Dear Sir—I inclose you herewith a communication received at the February meeting of the Northwestern Railway Club, which I was directed

to refer to your association. As the same is explanatory, I transmit it as received.

Yours very truly,

F. A. Foque,
Secretary.

St. Paul, Minn., February 10th, 1896.

Mr. Geo. D. Brooke,
President, Northwest Railway Club:

Dear Sir—In the report of the November meeting of the New York Railroad Club, given in the "Railroad Gazette" of January 17th, is found the following remark by Mr. Parke, of the Westinghouse Air-Brake Company: "For instance, Messrs. Jackson & Woodin are to-day offering to sell to railroads the Master Car-Builders' brake gear complete for a price about one-third of the lowest estimate that he, Mr. Parke, has ever seen handed in by master car-builders to their superior officers." Of course, this remark does not commit Mr. Parke to anything definite, since he does not specify what estimates he may have seen; but anyone reading the above, and knowing the position held by him with such a corporation as the Westinghouse Air-Brake Company, would naturally be led to the conclusion that it costs a railroad company at last three times as much to apply air brakes, or rather to manufacture the brake gear, as it does a manufacturing concern, and in that way certainly it casts a severe imputation on the efficiency of the machinery department of the railroads where Mr. Parke is acquainted with the master car-builders. Not only does it apply to roads where he is known to have access to any estimates that might be made up, but other roads, and especially Western roads with shops presumably less well equipped with special machinery than those of the older roads in the East, are liable to get the impression from his remarks that there is a large saving to be made by buying this material direct from some manufacturer.

In an estimate recently made up by one of the roads running into St. Paul, the total cost of making the material required for applying air brakes to a 36-foot car, exclusive of the material received from the air-brake company, but including the road's standard trussed brake beam and all pipe and fittings, was estimated at $28.68; this estimate, as far as labor was concerned, was not based on large orders, but was the actual cost of work that had been turned out in small quantities previously, and the actual cost of the work which is being turned out is running considerably below that estimated. We shall be in a position in a few weeks to give the actual cost to this road of turning out the work in comparatively large quantities, but for the present we will simply confine ourselves to the estimate, which we can assure you is higher than the actual cost of the work. Of the $28.68 the material cost $21.56, the labor $7.12; these are actual costs, without anything added for deprecia-

tion, storehouse expenses, or superintendence. The cost of the material is based upon iron at a price of $1.35, with extras as per list, bought F. O. B. at St. Paul.

Now, while we would not mind admitting that Messrs. Jackson & Woodin might reduce the cost of labor to a certain extent, it is highly improbable that they could largely reduce the price of their material, unless they use a very inferior grade of iron. Even supposing that their labor costs them nothing at all, they would have to reduce the cost of their iron to about 60 cents to be able to compete at one-third of the above estimate. As a matter of fact, this statement of Mr. Parke's is entirely misleading; and if, instead of saying that they could furnish the air-brake material at one-third the cost of the estimate made by the railroad company, he had stated that a railroad company with properly equipped shops could make their own air-brake material as cheaply as any manufacturing concern could supply it to them, he would have been a great deal nearer the truth, and he would have avoided making a statement which, from a man in his position, is liable to give general officers of railroads the impression that their machinery departments are poorly managed.

We would suggest that the Northwest Railroad Club refer this letter, with any additions or alterations that the meeting choose to make on it, to the New York Railroad Club, with the request that it be accepted as correspondence on the topical discussion held by them at their November meeting; and if they want any further details to substantiate our statement, we will give them the individual cost of each piece of foundation brakes, blueprints of our standard brake rigging, and the specification under which our merchant bar iron is purchased, and will challenge any manufacturing concern in the country to turn out brake gear at a relative cost that will support Mr. Parke's statement. We attach our names for your satisfaction, but should prefer to have them withheld from publication.

Yours truly,

J. O. PATTEE, Superintendent of Motive Power.

H. H. VAUGHAN, Mechanical Engineer.

The PRESIDENT—Mr. Parke is present to-night. Would he like to say anything?

Mr. PARKE (Westinghouse Air-Brake Co.)—Mr. Chairman, I think that the criticism by the officers of the Great Northern Railway is, to a certain extent, at least, justified. I desire to say that the statement which I made at the November meeting of the Railroad Club was made under a misapprehension. This matter first came to my attention from the Secretary of the Club, to whom I wrote an explanation, and it subsequently appeared—practically the whole of this communication to the Northwest Railway Club—in the "Railroad Gazette." I wrote to the "Gazette," explaining my position in the matter. I think it is quite proper that I

should make that explanation again here. It will be remembered that the topical discussion at the November meeting of the club was devoted pretty largely to the question whether it is good policy for railroads to attempt to manufacture, or whether they can to better advantage purchase from manufacturers. Two or three days prior to the November meeting of the Club, I had received from the Jackson & Woodin Company a communication in reply to a question from me as to the price at which they could furnish what I understand to be known as the Master Car-Builders' brake gear. I had learned that they were furnishing that brake gear complete to a considerable number of roads where they were applying air-brakes to their old freight cars. This reply gave a price. I do not remember precisely the wording; but I think they said they would furnish this brake gear at a price "all around" of so much. I did not have time then to analyze the matter, but I was particularly struck with the fact that it was a remarkably low price. During the topical discussion at the November meeting, while making some remarks, this matter occurred to me, and struck me as an excellent illustration of the matter under discussion. Making a very large allowance, so as to be on the safe side, I said the price was not more than one-third of any estimate I had ever seen—it was in reality considerably less than one-third. Further, in order to be quite sure that I was not saying anything without authority, I gave my authority. On account of the remarkably low price, I subsequently wrote Jackson & Woodin, indicating my surprise at such a low price, and received a prompt reply stating that the price quoted was not intended to cover the apparatus complete, but was the average price per hundred pounds. Had I taken the time to investigate the matter when it first came to my attention I would have seen that it would be impossible to furnish the brake gear at the price quoted, and I therefore would have come to the conclusion that there was some mistake about it. Having made the unfortunate remark, I was a little nonplussed as to what I had better do. It was impossible to recall the meeting—it had passed and the members had gone home. It was two or three days afterwards, and not having heard any criticism from it, I rather thought that if I undertook to make any published explanation of it it might look as if I over-estimated the importance of it, and my only regret was that it might get the Jackson & Woodin Company into some warm water. They did not complain and no one else did, and as time went on I concluded that my course was a wise one. Finding now that the officers of the Great Northern have been distressed by it, I regret that I did not make explanation sooner. This matter coming now, with the request that it be recorded as a part of that discussion, putting the prices as it does, and serving me with several strictures, I feel that I ought to be entitled to say a little respecting the statements of the letter. They give a price of $28.68 for the entire brake gear. I distinctly stated in my remarks that I was talking of the Master Car-Builders' brake gear. So far as I am aware, the only brake gear known as the Master Car-Builders'

brake gear is principally that apparatus intervening between the brake cylinder and the brake beams. It is illustrated and set forth in full, as a standard of the Master Car-Builders' Association, on sheet No. 9 in the report of the proceedings of the last Convention. I do not understand that it includes brake beams or pipe and pipe fittings. So far as brake beams are concerned, if the Master Car-Builders have a standard brake beam, it must be a brake beam which meets their standard requirements. They do not specify, as far as I am aware, any particular form of brake beam; but they do specify the requirements of a brake beam. I have endeavored to learn what the standard brake beam of the Great Northern is. I do not know positively, but I am credibly informed that it is a trussed wooden beam. I never have seen a wooden brake beam, trussed or untrussed, which will continuously fulfill the specifications of the Master Car-Builders; and if it is true that the brake beams included in the statement of cost in the communication, are of any form of wooden beam, I doubt very much if they might properly be considered up to the Master Car-Builders' standard. I have no desire to be captious, or to enter into any criticism of the communication from the officers of the Great Northern Railroad; but I cannot avoid making use of their figures for an illustration of the desirability of their purchasing their brake gear from manufacturers. Assuming that their brake gear, including brake beams, costs them what they represent for labor and material alone—which they distinctly state—without any question the total cost of the complete brake gear in the end to the Great Northern road is not less than 15 per cent. greater than that of labor and material. If they were a manufacturing concern and had to sell their material, it would cost considerably more than 15 per cent. in excess of that for labor and material. Giving them the benefit of the doubt that they do this at the lowest expense, that would make the net cost to the railroad company very close to $33. Deducting from that, as nearly as I can estimate, a pretty fair allowance for the brake beams, brake hangers, pipe and pipe fittings, so that the balance shall represent the cost of the Master Car-Builders' brake gear, the sum remaining will depend upon whether they are using inside or outside-hung brake beams. In order to be entirely liberal, I will assume that it is outside beams, which would indicate that of that $33 it costs the Great Northern road between $17 and $18 for what is known as the Master Car-Builders' brake-gear, on their own estimate. They can purchase that brake gear to-day of excellent quality, in accordance with Master Car-Builders' specifications, for $12. Wherefore, in spite of the fact that I think they do their work remarkably cheap if they are doing it at such prices, it is costing them somewhere in the neighborhood of 40 or 50 per cent. more than if they bought the apparatus of a manufacturer who is specially equipped for doing that sort of work.

The PRESIDENT—This letter, gentlemen, demands some action on the part of the club, and I leave it to you to decide how we shall dispose of the matter.

Mr. MENDENHALL (Pennsylvania Railroad)—Mr. President, I move that the letter be printed and Mr. Parke's remarks be incorporated in our proceedings.

The motion was seconded and adopted.

The PRESIDENT—If there is nothing else to offer under the head of "New Business," we will call it closed and proceed to the discussion of the next subject—technical discussion.

Mr. F. E. HAFF (Long Island Railroad) presented and read the following paper.

How Can Our Station Service Be Improved?

In a short paper of this kind it is necessary to observe some limitation, and I have drawn the line at terminal service, confining myself briefly as possible to a consideration of the subject as applicable principally to local stations. From my point of view this is the most important phase of the subject, my experience being that it is the way-station, regardless of its size or importance from a revenue-earning standpoint, which is most susceptible to improvement, and requires the most unremitting attention on the part of the head of the department entrusted with the superintendency of the station service. In the operation of railroads it is the attention given to little things which brings the greatest measure of success. The little economies of operation practiced here and the small savings of material affected there, apparently insignificant standing alone, when taken in the aggregate go a long way towards making the stockholders' dividend possible. So I say, if we would build up an ideal station service, we must commence to effect our improvements locally. Once we get the machinery of a perfect method in operation at our way-stations, the terminals may reasonably be expected to take care of themselves.

The station department of a railroad may not be inappropriately characterized as the backbone of its fiscal system. Upon the proper organization and operation of this department depends the safe and efficient collection of its revenue. The reputation of the railroad company is enhanced or marred according to the degree of efficiency displayed by its station employés. The living stones in the foundation on which the superstructure of the station department rests are the station agents. They are the primal representatives of the company itself. According to the impression they make upon the traveling and shipping public, the company's reputation is either impaired or improved. An efficient, courteous, painstaking, intelligent corps of agents, thoroughly alive to the interests of the company they represent, can do more to build up that company's reputation than almost any other calculable force. It is with the agent that the public comes in contact initially. From him and his surroundings it forms its first and generally most lasting impressions. Finding him surrounded by a poorly constructed, illy ventilated, dirty and otherwise unattractive depot structure; careless of personal appearance, gruff

in manner and lacking in courtesy in his dealings with patrons; it is apt to set that road down as belonging to the non-progressive class. But, if, on the other hand, he is found ensconced in an attractively built, scrupulously clean station, with neat and well-kept depot grounds, ornamented possibly by a small lawn or a little shrubbery; himself neatly uniformed, of pleasing demeanor, polite and affable in his intercourse with patrons, intelligent and well-informed concerning every phase of his work, always manifesting an accommodating spirit while keeping within the rules laid down for his guidance; the company naturally receives credit, and is referred to by the public as a first-class, progressive line. These are self-evident facts, needing no elaboration.

In discussing the question of how we can best improve our station service, it is essential that we first fix upon an ideal—a standard of excellence—which, while in no sense Utopian, shall yet be high enough to command ambition's most energetic pursuit, and which, while ultimately attainable, can only be reached by the closest possible application, coupled with the exercise of the highest degree of intelligence in solving the numerous and complex problems necessarily encountered daily by the thoughtful, conscientious and progressive superintendent. We are all, to a certain extent, creatures of environment; and if, in attempting to outline a standard and method of attaining it applicable to other systems, I adhere from pure force of habit to conditions existing on the line by which I am employed, I trust that fact will not detract from whatever of practical value there may be in the suggestions offered.

We are living in an age of specialties. The successful man of to-day is the one who pursues with all the energy of his being some particular line or branch of a profession, where formerly men sought to cover the calling in its entirety. In medicine it is not now the general practitioner who becomes noted and makes a financial success, but the man who studies and practices in its last analysis some special branch of the profession. This is equally true of the law, electrical science and other kindred pursuits. In the railroad world it is not so very many years back since a superintendent was supposed to be competent to handle and expected to be familiar with the details of all the departments of the work; and perhaps he was competent, considering the extent to which the various departments were then developed. He had perhaps been a train water-boy, worked on a section, had experience as a brakeman, baggage master, conductor, and could, if necessary, get in the cab and run an engine. Promotion was rapid in those days, and education and special fitness cut no particular figure when practical experience and theory had not yet been harnessed to pull together. But it is different now, and every year sees railroading develop into a more exact science. As this developing process goes on, the requirements of official position become more and more exacting, and a greater measure and perhaps higher class of ability is called for. Practical experience must be supplemented by the theoretical or college

education designed to fit a man for a special branch of the service. Education and experience must go hand-in-hand, and in railroad management to-day (and it will be true to an even greater extent in the future) the higher the education the better use will its possessor be able to make of his experience, the clearer will be his deductions and the more forceful their application to the problems he is called upon to solve. And as the forces of special education and fitness for special lines of railroad work become more and more essential, the managers of our railroad systems will come to a fuller recognition of the desirability of dividing rather than combining responsibility in the various departments, and specializing, as it were, certain branches of the work hitherto looked after by the head of one department. I believe that one of the very first changes this latter-day tendency to specialize will bring about is the creation of what may be termed the station department as a separate and distinct branch of the general transportation service under a responsible head. I believe that the work of the station employés is sufficiently important in its relation to the public and other parts of the service to warrant its organization as a separate department. The change once effected and placed in charge of a competent superintendent, one who has himself been brought up in the station and telegraph service, and you have the key to the solution of many of the problems concerning an improved station service.

Do you ask why similar results are unattainable under the present system? That is readily answered by the incontrovertible fact that the division superintendent, who on most roads has the superintendency of the station service, the employment and discipline of station employés, must necessarily give the greater and best portion of his time and study to the requirements of the train service. In a great measure his position depends upon the success and skill with which he handles his trains, and station service must necessarily be given second place—not from any lack of appreciation of the importance of station service on the part of the division superintendent, but simply and solely because the greater prominence he is forced to give the train service naturally crowds station service into a minor position in his management of the department. So while I speak from a personal standpoint, and in the light thrown upon the subject by more than three years' experience at the head of a station department, I can do so with a reasonable measure of confidence. As I said previously, this is an age of specialties; and I contend and firmly believe that the importance of the part played by station employés in the operation of our modern railroad systems, or the latent possibilities of the future development of this branch of the service, and the resultant benefits of such a development, will sooner or later be recognized by progressive managers and a special station department created. It may be said that I am prejudiced in favor of this division of labor and responsibility, and I will admit freely that I am. That is why I am here to-night; that is why I was asked to write this paper. It is a prejudice, however, or rather con-

viction, born of experience and fostered by observation and study. There is just as good reason for a separate organization and supervision of agents and operators as any other class of employés. Station service, comprising the care of station buildings and grounds, together with the employment and discipline of station employés, is as important and equally as worthy of separate departmental relations with other portions of the service as the motive-power, maintenance-of-way or train-service forces. The variety of interests intrusted to agents and operators makes it essential that they be subject to the most intelligent supervision and discipline available.

Keeping in view, therefore, the points I have thus far tried to make, I would say in answer to the query "How can our station service be improved?"—first, by the organization of all station employés into a separate department, and placing at its head a superintendent of station service. He should bring to the management of the station department a thorough personal knowledge of all the details of agency and the telegraph service, to enable him to judge of the qualifications of his men and set up a standard of excellence in that direction. He should, while maintaining strict discipline, be able to infuse into the employés of the department a strong feeling of loyalty or "esprit de corps." Such a condition is attainable by educating the men to realize that the prosperity of the company is the best guarantee of their own success, and by letting them see that their efforts to promote the company's interests are appreciated. Once intelligent men understand that they are not to be condemned without a hearing; that all complaints against the service will be thoroughly sifted, and the responsibility accurately placed; that infractions of the rules will meet with certain and prompt reprimand, suspension or dismissal, according to the gravity or nature of the offense, after a fair and impartial investigation, and that all honest endeavors on their part to improve the service and better the conditions by which they are surrounded will be as surely rewarded by commendation and promotion, and the question of loyalty will not only be effectually settled, but its effect in the increased efficiency of the station service will be immediate and pronounced. The superintendent of station service should possess the requisite ability and be clothed with the necessary authority to treat with the general public direct on all matters pertaining to the conduct of station business. To him and him only should all station employés report directly on all questions affecting matters at their respective stations, conducting with other department chiefs only such correspondence as ordinarily emanates from their respective departments. It should be incumbent upon him to study the varying conditions of business at the individual stations, and recommend from time to time such changes or improvements as his experience demonstrates the different branches of the service require. He should not be hampered by too close application to the clerical work of the department, but be free to keep almost constantly on the road, circulating among and acquiring close personal knowledge of the individual qualifications and character

of the agency employés, while keeping in touch with the detail work through the closest possible inspection.

Turning from a consideration of the superintendent to the matters under his charge, let us first take up briefly the question of station buildings and their relation to an improved station service. In the first place, while it is not essential that the way-station be a marvel of architectural beauty, the depots, when new ones are built, should be constructed with a view to meeting in the most convenient manner possible the known requirements of the major portion of the company's patrons at that point. Conditions governing the quality and extent of railroad patronage differ at almost every town along the line of a majority of roads. If the station department is in charge of a competent man he will thoroughly understand these conditions, and be in a position to advise the management accurately as to the size and general make-up of the station buildings required for present as well as future needs. The head of the building department and the head of the station department should be very closely connected and work in perfect harmony if the company's best interests are to be conserved, though as much might be said of all officials. Especially is this true not only in the matter of construction of station buildings, where free and full consultation should be indulged in, the one planning the construction of such a building as will best meet the exigencies of the situation set forth by the other, but in the location of station buildings as well. It is in this respect that there is room for the greatest exercise of judgment. While little can be done to improve the situation if present structures are not properly located, in the case of new stations the greatest care should be taken to select the best possible site, taking into consideration the most convenient approach for patrons from the town such station is designed to serve, with some respect as well to the logical direction of the town's probable growth and development. Furthermore, if there are any within the sound of my voice who have ever worked in the capacity of station agent, they will at once appreciate the suggestion that in selecting a suitable location for passenger and freight stations the comfort and convenience of the station employés are also of paramount importance. A little foresight in this direction often results in effecting a very material saving of labor in conducting the agency; while ignoring the idea, on the other hand, frequently leads to increased cost of maintenance and operation, and instanced in the location of freight houses in small towns at a sufficient distance from the passenger station to necessitate the employment of an assistant or separate freight agent, where one man could handle the entire agency without help if all branches of the service had been more compactly grouped. Siding and yard facilities are also very important items which should receive careful consideration before a station site has been irrevocably fixed.

With station buildings and platforms designed, located and constructed wholly with a view to affording the safest and most convenient as well as

economical service to the patrons of the line, by far the most important factor of the situation yet to be considered is the station agent and his subordinate employés. In him, in the opinion of the writer, centers 90 per cent. of the possibilities of an improved or ideal station service. How shall he be discovered? what shall be his composition when found? how shall he be handled when employed? are all questions requiring deep and conscientious study. The ideal local agent and operator is as complex in his general make-up and qualifications as a Chinese toy. Like St. Paul, he must be all things to all men. His duties are multifarious and exacting. He is responsible for the collection and protection of all the revenue. He must secure for the traffic manager all the business originating in his territory, or be subject to censure for lack of interest or efficiency. He must be an expert accountant, keeping an intricate set of books and records, and make an incredible number of reports to the auditor and other chiefs daily. He must be a first-class telegraph operator, as upon his shoulders, equally with the despatcher and train conductor, rests the safety of trains run by telegraphic instructions. He must put in from ten to twelve and even fourteen hours of continuous service every day in the handling of freight, express, baggage, tickets and telegrams, and not infrequently the United States mail, observing hundreds of rules laid down for the protection of the company by which he is employed. He must be prompt, energetic and efficient at every point. He must be constantly on the alert to secure new business, and in all his dealings with the public, polite, courteous and accommodating, avoiding giving the least offense. In addition to his daily, weekly and monthly reports, he must conduct with promptness and despatch a voluminous correspondence emanating from almost every department of the service. He must not only keep his person and uniform immaculate, but his station scrupulously clean—floors, windows, lamps and every part of the premises in a neat and attractive condition, as well as his station grounds and surroundings. He must keep careful watch of, and report promptly to the head of his department, all necessary repairs or measures which should be taken to secure absolute safety and protection to the lives of patrons and the property entrusted to his care. These are apparently minute details of agency work which may appear to some as too insignificant to treat of in a paper of this character, but in order to arrive at a correct understanding of the subject they should be kept in sight; for, recurring to my central thought, that through the evolution of the agent must we look for the highest development of station service, it is important, in order to measure his requisite qualifications, to keep in view the obstacles with which he will have to contend.

The next step to be taken looking toward an improved station service, as the writer has learned from experience, is that of infusing into the daily routine and habits of all employés of the department what might possibly be termed the "station service idea." This will be found to be an educating process the extent of which will depend largely upon the character and

previous training of the men already in the service. The modern ideal agent is not born, but is the product of a growth, and I know of no profession in which this growth is slower. Some men attain to a standard of excellence in the agency work in three or four years after passing the probationary period; some take from eight to ten to reach it; and some creep into the service and, through seniority or perhaps equally as unwarrantable avenues of promotion, into important and well-paid agencies who will never attain it. This latter class, either through lack of a rudimentary education or inability to appreciate the requirements of the position, should never have been allowed to enter the station service in the first place. This educational process must be continuous—not only because of frequent changes bringing new men into the department; but because each year the conditions of service, as railroading becomes more and more an exact science, change perceptibly, and the wide-awake superintendent must keep his department up with the procession or make way for some one who will.

One of the first things in this scheme of education is to impress indelibly upon the minds of each employé of the department the fact that strict discipline will be maintained—not an oppressive, one-sided discipline; but it should be understood that all rules are issued for observance, and any conviction following an infraction thereof will be followed by certain punishment, according to the gravity of the offense and the effect sought to be produced upon those who might be tempted otherwise to break the same rule.

While the superintendent is educating his men already in the service up to a broader view of the importance of agency work, so far as it concerns the reputation and success of the company by which they are employed, he should exercise the greatest possible care and judgment in the selection of new material for filling vacancies. It may not be essential to the efficiency of the department; yet so general has become the knowledge of telegraphy, it would seem best to place in charge of agencies only men who are themselves operators and thoroughly acquainted with the telegraph service. This knowledge is invaluable to the station agent at the larger stations, even if not called upon to use it personally, for it enables him to hold to a more strict account and proper performance of their duties the employés under him who are connected with wire work. Concerning applicants for positions, too much care cannot be expended in looking up their previous records. As already shown, the interests of the company intrusted to the station agent are too vast and his influence too far-reaching to warrant the appointment to such a position of any but representative men—men whose past record will bear the best test of loyalty; men who have proven faithful to the trusts reposed in them and the performance of every duty; men of good personal address and moral character; men of good rudimentary education outside of their special knowledge and experience in the railroad service; men of pleasant demeanor and who will treat patrons with courtesy and politeness, and

whose training and character will enable them to transact the business of the company at all times in such manner as to win the approbation not only of its officials, but the public as well. Men often tell me this is impossible. They will say such-and-such a man is a veritable crank, and no one can do business with him without losing his temper; but my invariable reply is, "I know better." If the will, the desire, be present, an agent can get along without friction with the worst specimen of this class known as "cranks."

But the responsibility of the progressive superintendent is not by any means ended when he has exercised the utmost care in the selection of his living material. Here comes in the educating process—the growth already referred to; and if he be a conscientious official, he will devote to this portion of his work the greater part of his time daily. Its pursuit involves constant personal supervision and inspection. Step by step, the men must be taught that in railroad service eternal vigilance is the price of position and prestige. Considering the multiplicity of duties devolving upon the busy agent, this growth must necessarily be a slow one. The superintendent may plan and the management expect lively and pronounced results from the adoption of a certain policy in this department; but where so many details have to be looked after daily, it is not safe to introduce innovations too swiftly, because of the danger of bringing about an unintentional neglect of some of these small but essential details. One by one, however, may be introduced judicious and salutary rules for the more efficient working of the department, and gradually, almost without knowing it, the entire personnel will have absorbed the new policy or idea and the desired improvement be effected. One by one, in this manner the careful superintendent will take up questions of vital importance to the interests of the service entrusted to his care, and by weeding out the careless and inefficient, non-progressive men, and replacing them with men keenly alive to the possibilities as well as the responsibilities of the positions they hold, bring this department up to a higher plane.

A great deal depends upon systematic inspection. I do not refer to general inspections at stated and well-known periods—whether monthly, quarterly or annually—which are so apt to be immediately preceded by a most vigorous application of brooms, scrubbing brushes, dusters, window washers, rakes, etc., only to allow these articles to relapse into a state of innocuous desuetude the moment the inspecting car passes. The inspection I have in mind is a daily one. The agents must be taught to expect an inspection—a personal visit from the superintendent at any hour of the day. Once they realize that he is liable to call at any moment, they will aim to be always ready, with their "lamps trimmed and burning." I have found that this very fact arouses a spirit of emulation, one vying with another to have his station present the more attractive appearance; and being always ready for inspection, they get into

the habit of looking forward to the visit of the superintendent with a certain degree of pleasure, where formerly, or under other conditions, such a call would inspire dread. These inspections should cover the condition of all buildings and surroundings, neat and attractive appearance of agents and other uniformed employés, condition of books and office records, cleanliness of floors, windows, lamp globes, platforms, etc.

As the regular passenger train affords no opportunity for so close an inspection as I have outlined, and a special is out of the question, except at rarer intervals and for more general purposes, the local freights offer the best means of carrying out this inspection idea. As a rule, the stops are long enough to take in the entire agency, and consult with the agent concerning his work and the requirements of the service at each point. Where the territory is obviously too large to admit of so close a personal inspection as that afforded by riding on the local freights, the superintendent will have to content himself with the more general inspection obtainable by travel on local passenger trains, supplemented by special trips to individual points. The idea is capable of expansion, however, and the general principles can be carried out just the same by calling to his aid one or more of his most efficient and best-equipped agents and assigning them to local inspection work on certain divisions of the line, reporting in writing to him daily the result of their inspection and special service.

In the conduct of these daily inspections, an opportunity is afforded for impressing upon agents of all classes—at the larger as well as at the smaller stations—that nothing tends so strongly to make their work easier and its results more appreciated by the management as the application of method, of system, to every part of their work, from the first hour of duty to the close of business. A close study of agency details, with a desire to respect the wishes of the superintendent in regard to the special points he is anxous to cover, should enable the intelligent agent to so map out his work that every moment will tell to the best possible advantage. It is an indisputable fact that the men who do apply methods of system and order are the ones who are first thought of when vacancies occur involving promotion. Confusion and inefficiency are certain to follow the absence of order; and if anywhere in the entire complex organization of modern railroads order and system are essential, it is in the performance of the manifold duties of agency work. It is, in fact, the supreme test of an efficient departmental organization.

I would like to make just one more point—and that is, the desirability of securing permanence of service if existing conditions are to be improved. Frequent changes made for change's sake are demoralizing in the extreme. Every change should tend toward an improvement of the service and, so far as possible, a promotion to all concerned. There are positions of importance and responsibility where the remuneration is comparatively small, in which we often find men of conspicuous ability. Perhaps they

fill the place so well that there is a temptation to leave them there; and unless conscience comes to the rescue, such men are liable to be taken off the eligible list. This is a great mistake, tending to discourage really able men from doing their best by making them feel that it is not worth while. The superintendent will find it work to his advantage, and the service be greatly improved, if the station employés are allowed to see that some one of their number who has made himself conspicuously worthy is selected for promotion whenever a vacancy occurs. The establishment of such a policy cannot fail to produce a salutary effect upon every intelligent man in the service, and must have a tendency to stimulate him to prepare himself for the duties of a higher position and renewed efforts to please. Thus the service will be made more attractive, the company secure better results, and a feeling of scurity and permanence be engendered among its employés.

In conclusion, I have tried to show that our station service is capable of development and improvement, especially on busy passenger lines—first, through its organization as a separate and distinct branch of the general transportation department, under a superintendent who thoroughly believes in the importance and ultimate elevation of this division of the service, and who by education and personal experience in station work shall be peculiarly fitted for the duties devolving upon him in the supervision of such a department; and second, by educating the station agent up to a more comprehensive view of the station service and the pregnant possibilities of its future development through its own educational growth, fostered by the close personal study, supervision and inspection of the head of his department. The best evidence of my faith in the results of such a course lies in the fact that I am using my best efforts daily to exemplify the ideas outlined above.

The PRESIDENT—What is your pleasure, gentlemen, with regard to this valuable paper presented by Mr. Haff?

The SECRETARY—I will read two letters that were received by the Secretary—one from C. H. Hopkins, Superintendent of the New York, Ontario & Western Railway, and the other from James Donnelly, Superintendent of the Lehigh Valley Railroad—as follows:

Middletown, N. Y., April 15, 1896.

W. W. Wheatly, Esq.,
Secretary, New York Railroad Club,
Foot West Forty-second Street, New York:

Dear Sir—Much improvement can be made if those in authority exercise greater care in the selection of persons to fill the various positions in and around the stations, especially those whose duties require them to come into contact with the public. If this is done and the station employés are in touch with the superintendent, harmony will exist and the service be made as near perfect as possible. In a word, fill the positions with faithful, competent, intelligent men, whose characters are beyond

reproach, and other things will follow as naturally as the flow of water down hill.

Yours truly,

C. H. Hopkins,

Superintendent.

Easton, Pa., April 9, 1896.

Mr. W. W. Wheatly,

Secretary, New York Railroad Club,

Foot West Forty-second Street, N. Y.:

My dear Sir—I may say, concerning the subject for discussion, that on a busy road where the passenger traffic is of sufficient importance to warrant it, as, for instance, the Long Island Railroad, or any of the roads centering either in New York or in Jersey City, a station inspector whose duties were faithfully performed would be a valuable adjunct to the service. In addition to this, however, it requires a pretty close personal attention on the part of the superintendent, or whatever officer of the system may have the station agents under his immediate charge. On some lines the superintendent's territory may be so extended that it might not be possible for him to give a very close personal attention to matters more than once a month, and he might not be able to visit his stations more than once in three months; but a short visit and a casual glance at surroundings will go very far towards having the stations kept in order and the service up to the required standard. This latter, however, may be somewhat of an indefinite unit, as the same standard in sections of country where the population is widely scattered need not be kept up to that of larger or more important towns. For roads, say, like the Long Island, I would say that a station inspector, or a superintendent of stations, as it is called there, is a useful adjunct to the passenger service of any road, and more particularly to one that has sharp competition from parallel lines.

Yours truly,

James Donnelly,

Superintendent.

The PRESIDENT—The subject is now open for discussion, gentlemen.

Mr. BERG (Lehigh Valley Railroad)—I would like to ask Mr. Haff what disposition he makes of the relations of the station agents to the auditing, traffic and accounting departments; and further, what general officer of the road he would expect the superintendent of stations to report to.

Mr. HAFF (Long Island Railroad)—I would say, in answer to the question of Mr. Berg, that on the Long Island road the agents report, as outlined in the paper, directly to the superintendent of stations on all matters concerning station business outside of the regular revenue and traffic

reports which are made directly to the auditor and traffic manager. Our organization there is such at present that the superintendent of stations reports directly to the general manager; but my impression is that on a majority of the roads this would not be entirely practicable. As outlined by Mr. Haines, President of the American Railway Association, in an address to that association last October, the general superintendent of transportation, according to his theory, should have two subordinate chiefs, a chief of train service and a chief of station service, making the units of the transportation service the station employés and the train crews. And that might possibly be considered the better way to effect the organization on a majority of the railroads; that is, to have the superintendent of stations—superintendent of station service would be a more expressive title— who employs and disciplines all employés in the station service, report directly to a general superintendent of transportation.

Mr. TODD (West Shore Railroad)—I would like to ask, in further reference to the remarks of the gentleman who sat down a moment ago, if an agent wants a freight rate, would he apply to the superintendent of stations or to the general freight agent?

Mr. HAFF—In that case he would apply direct to the traffic manager or general freight agent.

Mr. TODD—I think this paper that has been read covers so clearly the matter under consideration that there is very little for anyone to add. I would like, however, to make one or two very small suggestions in regard to the neatness of the stations, which has been touched upon very strongly in that paper. My personal opinion is that one of the most displeasing things to a station is on the inside, especially in the waiting-rooms, where there are a large number of advertisements and documents displayed in a careless way upon the walls. The traffic department is very largely responsible for that. They are forced to have placed there a great many tariffs, both freight and passenger, by the Interstate Commerce Law, which says that they shall be so displayed upon the walls. But I think it is now a recognized fact that the law can be complied with without this. Those in charge in Washington are now satisfied, though they were not at first, with a neat notice framed and hung upon the wall of the waiting-room, stating that a complete file of all freight and passenger tariffs are with the agent in the station office, where they can be seen upon application. I think it is now satisfactory. I had the question up with the Interstate Commerce Commission officers in Washington several years ago, and they declined positively at that time to admit such a construction of the law; and I think you, gentlemen, will agree with me that this will go far to help keep the station looking clean, and this plan can be adopted if it is recognized as a legal notice. The D. & H. do it, and it makes a very important improvement in the appearance of their waiting-rooms. I do not think that I am prepared to say that I am opposed entirely and absolutely to all advertisements in stations; but the practice is entirely too indiscriminate

at the present time. The old "tack-hammer man" still goes the rounds, and nails up in the waiting-rooms directions to "buy your ticket by the M., K. & T.," or to "travel by the Northwestern," or some other road, which does not bring that road a passenger a year and it does disfigure the stations very much; I think that is a matter that should be looked into, and I am prepared to say that it should not be allowed in a station except by the permission of the division superintendent or other proper officer of the road. I would like also to say a few words with regard to the duties of station agents to the heads of departments, and particularly to the heads of the freight and passenger departments. There is a most remarkable difference in the agents at the smaller stations, in regard to making reports of matters of interest to the company through the proper officers. I have been very much struck with the promptness of some of these agents, where a man had taken away two or three carloads of freight and was sending it by a competing line, writing or telegraphing to the proper officer. On the other hand, I have known of a case where a shipper had taken away traffic for six weeks and I think possibly that the agent had not missed it at all—or it had possibly relieved him of so much work, and therefore he did not wish to report the matter. The foundation of the agent's position and of his success, and of all the officers and employés of the road, is revenue, and it is very hard sometimes to get enough of it to keep the roads going—I think the stockholders can, as a rule, testify as to that—and it is just those little things, as has been said—those little, very little things—that will lead to building up the revenue and the treasury of a railroad. A line that does a very large proportion of so-called through traffic, no matter how large that proportion is, finds that it sinks into insignificance in comparison with the traffic from their local stations, which I think most railroad officers from the management down are too apt to neglect. So we go about to win a good competitive business and get freight from the other fellow, while we could develop a local business which would remain our own to a great extent, and here is where the force of a station agent doing his work properly comes in. It is well known that industries and manufactories are going up in various parts of the country on the different lines of railroad at all times. It is hardly possible that a factory should go up in any small village—where they naturally go—it is hardly possible it can go up without being talked of one, two or three months previously. Now, if a station agent does his part, he repeats that gossip, or whatever you may call it, to the proper officer. He at least can make a memorandum of what he hears, and give the gossip or rumor, whatever it amounts to, to the division freight agent when he comes along; and if he hears that he is on any train on the road, if he is alive to the situation he telegraphs him that he has something he wants to see him about, and he meets him at the train and tells him what he has heard, and there his duty in the matter ends. He has started the ball rolling. It is often impossible for him to go and investigate the truth or falsity of these

rumors; but he should make a memorandum of the matter while traveling, it seems to me, and turn it over to the proper officer who has time and who is there for just such a purpose and to secure traffic, and if he thinks it worth while he will investigate, and if he does not think so he is responsible for not taking action. I think, too, that there is rather a feeling among station agents that the first qualification is that a man should be a telegraph operator. It is very true that that is a necessity in most cases; but there is a feeling that if they satisfy the requirements in reporting trains and handling messages, that is all that is expected. I do not say that of all station agents, but of many of them—I have noticed it so often. I have noticed also that there is a disposition on the part of operating officers, where an agent was very remiss in other duties, not to discipline him or remove him because he was a good operator. Well, now, that telegraph operator has got to be paid and others have got to be paid, and there has got to be money in the treasury to pay him, and therefore the traffic department is of some importance in connection with the agents. I was very much struck with what has been in the papers recently with regard to a circular letter sent out by the Vice-President of the Illinois Central Railroad, addressed to the agents at all the small stations, with regard to keeping themselves posted as to any action taken or proposed to be taken by the local authorities which had a bearing upon the interests of the railroad company; it would be a very easy matter for a station agent to keep track of these things, and the circular rather encouraged the agents to become members of the village councils, or in some way to get posted and report to the proper officer what occurred or was about to occur. I thought there was a good deal of force in that—it would not only give the company an immense skirmish line, but it would make the station agent feel that he was of some importance—and I would simply like to put forth that suggestion for the traffic department, both freight and passenger.

The PRESIDENT—An invitation was extended to the local freight agents of the city to be here to-night, and if there are any present we would be glad to hear from them. I am not personally acquainted with them, but I hope they will not be backward in giving us their opinions.

Mr. BERG—The paper read this evening is very interesting and valuable. It brings up a very important subject, and I think it was handled in good and elegant shape. I am prepared to accompany Mr. Haff's suggestion a long way, but I cannot go quite as far as he does in regard to the placing of the local station service under a special official—that is, everything, the entire station service, every branch of it, under him—and that official becoming thus more of a general official of the road. I recognize, as brought out in the paper so excellently, that a local station agent occupies probably the most anomalous position of any railroad employé. He has the greatest variety of duties; he has probably more direct and indirect bosses than any other employé, and he is also liable to come into conflict with subordinate officials and employés, owing to a conflict of

jurisdiction. It is unnecessary for me to explain or to elaborate what the duties of a local station agent are; but I would say that when I refer to the number of bosses, I refer to the fact that he receives orders and does work under the supervision of the division superintendent, of the trainmaster, the master of transportation, the general freight agent, general ticket agent, general baggage agent, superintendent of telegraph, the car agent, the superintendent of the express business, and then the officials of the auditing and accounting and traffic departments. When I referred to the liability of conflict of authority with subordinate officials and employés, I meant to indicate the uncertainty that sometimes exists as to the responsibility for the care of the depot and depot grounds, in spite of regulations in a book of rules placing certain duties upon the superintendent of buildings or upon the roadmaster to see to the proper care of the buildings and station grounds. I think, therefore, with Mr. Haff, that the agent of a local station, to be a model agent, would require so many characteristics and virtues that it is almost an impossibility to get such a man off-hand, especially at the low rates that the railroad companies can pay or are paying to the station agents at small stations. Therefore, there will always be among the large number of men that are employed some who will be dilatory in their duty and who will constantly need careful supervision and inspection. I will refer to several points in regard to the depot and station service entirely outside of the purely clerical work, and the relations of the agents with the traffic and auditing departments, viz., the necessity for keeping the grounds and depots neat and clean, and of not allowing anything of a combustible nature to lie around which would be liable to cause the spread of fire, such as waste or drippings of oil, or rubbish of any kind in the rooms or underneath platforms. Furthermore, an agent can become very delinquent by neglecting the care of the toilet rooms. In small stations where there is only one toilet-room compartment, the compartment is very often used as a general storehouse for the agent, for mops and brooms, coal hods and lamps and such-like. There are a number of other points. The discussion could be extended indefinitely if we went into all the points in which it is necessary to have constant supervision, so that agents will come up to the mark and model established for them. I think the remarks by Mr. Haff, especially his remarks referring to this point, certainly illustrate that there is room for improvement and that constant inspection and supervision are necessary. The question now is whether the present system accomplishes anything of value. With the exception of the periodical inspection at stated times, referred to by Mr. Haff, of which the agent usually has notice on most roads, I agree with him that the superintendent and men nominally in charge of the station agents really have not time to devote to this branch, unless they have a hobby in that direction, viz., to keep the station service up, and in that case some other branch of the service will be left to a subordinate and not receive their close personal attention. The trainmaster and master of transportation, while

supposed to represent the division superintendent, are about in the same position as the superintendent, engaged with their own particular class of work, while the superintendent of buildings and the roadmaster only have a limited authority as far as the physical features around the depot and the grounds are concerned. From this I am forced to the conclusion that the present system, as a rule, does not tend to properly superintend and supervise this very important class of railroad service. I agree with Mr. Haff that the appointment of a special officer, experienced, trained and equipped for the position, is imperative and necessary, and will produce excellent results; but I would place this officer under the division superintendent—in other words, as an assistant to the division superintendent—and further, the entire clerical work and the relations of the station agent to the accounting, auditing and traffic departments should be handled directly from those departments with the station agent, and not through the superintendent of stations, which would simply be augmenting the amount of work and putting in an intermediary office for the correspondence to pass through, thereby causing delays. The reason that I advocate that the superintendent of stations or inspector of stations, or whatever title you choose to give him, should be an assistant to the division superintendent, is that I am a strong believer in the principle that the division superintendent shall be in charge of and theoretically, at least, cognizant of everything going on on his division. In order to make practice agree with theory, it is necessary therefore to give the division superintendent an efficient staff of first-class assistants, and the superintendent of stations or inspector of stations will in connection with the roadmaster, the superintendent of bridges, superintendent of buildings, the trainmaster, master of transportation, etc., make a valuable addition to the division superintendent's line of first-class, right-hand assistants. I consider that one of the errors of railroad organization to-day is that the heads of departments are generally left without a proper number of first-class assistants. It becomes, therefore, necessarily their duty to deal constantly with petty details which, if pursued year in and year out, will soon take the energy and vitality from the best railroad man, and soon force him to quit the role of a prominent progressive railroad official and simply become a mere unit in the railroad machine.

A MEMBER—It seems to me that there are two important questions connected with railroad station service that have not been touched upon this evening. One of them to a large extent affects the small railroad stations. The station seems to be considered public property, and not the property of the railroad company; for the most of the time the depot rooms are occupied by a class of individuals with which we are too familiar—the railroad loafers consisting mostly of hackmen and idle men and boys of the small villages and towns—and it seems to me it would result in a vast improvement, the enforcing of the idea that railroad stations are railroad property, not public property, and are to be kept for the use of the patrons of the road. A great many stations throughout the country—and, it would

seem, a majority in the small towns—get very disagreeable from this cause alone. The strict enforcement of the principle that the station is the railroad company's property, and not public property, would very much aid the company in maintaining a neat and proper appearance of the station. The other point in connection with the improvement of the service is the matter of platforms and arrangements for entry and exit, which, of course, would vary with the character of the place and the surroundings; but the question of platforms alone seems to be one that is given very little study by railroad men. There are few stations, I think, in the immediate vicinity of New York that can come within the proper requirements of what a local station should be in the matter of platforms. Many of them are very dangerous, inconveniently and improperly arranged, and it seems to me this can be given greater attention and result in great improvement.

Mr. VREELAND (Metropolitan Traction Co.)—I think the thanks of this club are due to Mr. Haff for two things—first, for the valuable paper; and second, that it has allowed us to get square on the transportation question. When I was on the Executive Committee last year a number of those transportation people said to me: "Why don't you propose something we can talk about? Why talk about such questions as 'How many tubes there should be in a boiler?' 'How many driving wheels should be under an engine?' 'What metal should be used in making bells?' etc. Those things are of no interest to us and we cannot enter into the discussion. Why don't you take up things connected with transportation?" Well, we have taken it up this evening and they have not talked. (Laughter.) I am not up to date on station service. A number of years ago I was connected with the Long Island road, with which Mr. Haff is connected, and in those days the position of station agents was not a very permanent one. When approaching stations we conductors used to figure on the tides and the weather, and as soon as the weather would be right for a good run of blue-fish, or wild-fowl were flying, or it was low tide for good clam-digging, we did not have any agents. At such times we used to find the key in the freight house, or some other place, and we would pick up what passengers there were and go on. I unfortunately left that road before they got onto this new era of railroad science. I went from there to another one of our large systems, which some of my friends here to-night now have the pleasure of managing, where I had to take the rails off the turn-tables and out of the engine house and sell them to get money to pay off with; and had to jack up cars, get out some of the wheels, and send them to the purchasing agent to be sold so as to get some new wheels to put under these cars. They wouldn't trust me for a full set of wheels. (Laughter.) On that road I had the same pleasant experience with station agents. We had agencies where a man needed a special train of his own to get to a boarding place after the train had passed. But seriously, I think the question of the station agent is a very important one in railroad work. He occupies a peculiar position from the fact that in all the other branches of the service that pertain to

transportation there is that slow education of the man along with others—he is not much of a factor in the service. The man goes in as a brakeman or a fireman and he is with the other hands for instruction. We hire a station agent and turn him out to work. He may be a man we have never seen before. We have looked him up some, and not gone back very far, perhaps, for fear we would find that we had not got an available $75 a month man for $45. And then there is the question of the express. Some of our railroad companies have taken away one of the greatest inducements we used to offer the agent—the express business. We used to say: "We will pay you $40 a month (for 18 hours a day); but there is the express! You can take that." I think the most they ever had was $8 a month— we let them find that out themselves, though. Some roads have taken that away now, and the superintendent does not even have that to place in front of the man, and as a result the timber we get for those positions is not of the very best. It seems to me, from the light I gathered while in the steam railroad business, that the railroad companies do not pay attention enough to the station service, particularly to the employés. The pay they ask a man to accept will not call out good men to that service. I think there is plenty of good material around the country if a fair rate of wages were paid for the various positions. The up-to-date question of station agencies I am not familiar with, because the city maintains all my stations.

Mr. CASEY (Erie Railroad)—A gentleman spoke about the village nuisance—I think that the one-room station would largely correct that. The trouble about this lounging is mainly in having the second waiting-room, which people can sit in and idle and smoke. I would like to hear some talk on the one-room station.

Mr. MOLINEUX (Lehigh Valley Railroad)—The general talk this evening has been on the improvement of the station service. I have noted three points which I will name. Agents should call out the destinations, or some of the destinations, of trains as they come into the station. You know it is done on some of the roads. There are people in the station waiting for the train east-bound or west-bound. The agent calls out through his window the destination of the train. Another point, agents should get as much information as possible about the time of trains, the time they are making, whether they are on time or not. The day after I got notice of this meeting I was a passenger at a station, and asked the agent where the train was. The agent was reading a paper and said he did not know. The train dispatcher's office was right over his head. I think some years ago the New Haven road abolished the one-cent fares—that is, made all fares end in 5 and 10 cents—and I understood it was done to facilitate the transaction of business at stations. If there are any gentlemen from that road here to-night, I would like to hear from them how that has worked. I once went to Boston and bought a ticket for $5. I got the ticket and got right out of the way quickly. When I left Boston the next night I handed the agent $5 and got two cents in change back with the

ticket. I did not object to the two cents, but I had to stop and ask a question, and the gentleman behind me had to wait. I would like to know if any gentleman can tell me with regard to that?

Mr. MENDENHALL (Pennsylvania Railroad)—I had not intended to say anything to-night, but Mr. Vreeland has rather forced me upon my feet. The paper has limited us to local stations. If Mr. Haff had not made that limit I do not know that any of us would want to criticise the paper at all (it is one of the strongest we have had), but he has taken us out into the country, and two or three of the gentlemen present have talked about the influence of the local agent. It occurs to me that that matter of his influence as affecting the revenues of the road, applies only to what might be called transient business. Now, at most of our local stations the business is non-competitive, and where the business is non-competitive I do not see that the remarks of the traffic men may apply; but where there is competitive business, of course they do. To include all the stations on the railroads, taking in the terminal stations, it will be found that the argument of the paper is being followed out to a certain extent. There are at large terminals, officers designated by the various titles, who have charge of passenger or of freight stations and the business in them, on the lines suggested by Mr. Haff. It is quite a question, I think, and one which should probably be discussed by the Association of Superintendents, as to the advisability of putting a station superintendent out on the line. On busy divisions the division superintendent must of necessity get over the line occasionally—very frequently on many of them—and where business is not large, as it will not be in many of our outlying stations, it does not occur to me that it would be too much to expect the division superintendent to look after that, and I think it is being done all over the country. The thought occurs to me that to carry out the suggestion would add another responsibility, and that is an objection in one sense. I would like to ask the gentleman who referred to station platforms if he has thought of any safer platform or any revised method of construction that he can suggest to us? I am sure that I have seen a good many station platforms, and they have had a great deal of discussion, and if there any improvements I think we might want to hear of them.

A MEMBER—I spoke of the improvement in station platforms. I had in mind particularly, stations that were set at an elevation above the track level, as in very many cases you find them, requiring a descent of two, three or four steps to reach the level of the track. This has always seemed to me to be a very dangerous practice. We find at such stations, in consequence of their elevation in this way, steps descending on the back to the street; and very often they are in the middle of the station platform at the back, with overhanging platform at the ends, without steps and with no railing, at which places a person at night is apt to walk off and hurt himself. It seems to me the ordinary local station should, if possible, be set far enough back from the track to allow either a graded

slope, or not more than one step down to a platform or paved way, or a surface of pulverized rock or stone which is run out to the track level. It seems to me that the elevated platform between the tracks, or elevated platforms above the tracks at stations, are very dangerous; and these platforms that are constructed, as a rule, of timber are very often not kept in good condition, are liable to curl up at the ends and are very dangerous. I think a large number of stations in the immediate vicinity of New York come within these criticisms, and I have one in my mind. I have traveled for many years on the New York Central; but the New York Central at present is setting a good example to the other roads in the very scientific construction of their stations; there is another matter in which they are setting a good example—the matter of station signs. This is a matter of importance to the railroad companies, and at the same time it is a matter very often of great convenience to the public—the display of the names of stations on small sign-boards beyond the station limits; but it seems to me that the question of station platforms is one of the most important that can be discussed in connection with the improvement of station discipline and the personnel of the staff.

Mr. CUMMIN (Long Island Railroad)—I had the fortune, if I may call it so, to become connected with the Long Island Railroad about the time that Mr. Vreeland left, and I can assure him that the blue-fish craze departed with the old management, and I doubt if he could find an agent on the railroad now, from one end to the other, that could tell him when the blue-fish were running, or which Saturday was clam Saturday. (Laughter.) It seems to me that the gentleman here on the left has brought out the true idea with regard to having clean local stations, in the one-room practice. At the time I became connected with the Long Island Railroad all our stations had two waiting-rooms—so-called "ladies'" and "gentlemen's." The gentlemen's was usually occupied by a lot of loafers, discussing their business and smoking such brands of tobacco as the "Hod-Carrier's Delight," etc., and telling stories which, while they might be appropriate among themselves, were not pleasant for ladies to hear. Although there were two rooms, there was a ticket office between, and a window with a slide connected the ticket office with both rooms, and the slides were generally up, so that there was no trouble for conversation to carry from one room to the other. We have done away with all that in all of our stations by adopting the single-room plan, and we allow no smoking whatever in the stations. A number of stations have sheds or wings on them, and if a passenger wants to smoke he can be accommodated. It seems to me that is one of the best moves toward keeping a station in a clean and good condition.

Mr. McCOY (New York Central Railroad)—The topic under discussion this evening is a very interesting one. I have listened with a good deal of interest to the paper read by Mr. Haff. There is one thought that he presented that I would like to speak about—and that is, with

regard to the deportment of the agent. If you can get an agent that is of good, clean character and good deportment, the matters of detail will take care of themselves. As the agent is the man that is brought into contact with the public, he is the one by whom the public forms its opinion of the management of the road. You take an agent that is careless and untidy about his personal appearance, and he will be so with his work; and the public is not slow to notice that. The public will conclude one of two things—either that the management of the road indorses that kind of work, or that the superintendent is not attending to his business. They form their opinion of the character of the road and the efficiency of its service from this man; that is, if the man is untidy and careless in his work he either has the indorsement of the superintendent and the management, or else the superintendent is not attending to his duty. I have always found that I could get along very well with the agents without the assistance of a station superintendent. If you look after a man's work carefully and see that he does it, the matter of detail will take care of itself. On the road with which I am connected, I find no difficulty in visiting the different stations along the line. Where you have a man you have to watch, or to send an inspector after him to watch him every week or every day, or twice a month, or such a matter, why the sooner you get rid of that man the better it will be for the road. A good deal that Mr. Haff had to say with regard to detail is all very well; but in order to have some one follow that up all the time, is simply making a place for someone, it seems to me, that is to come in between the superintendent and the agent. A little incident occurs to me that happened on a road that I was once connected with (in connection with what Mr. Vreeland was saying), that shows the kind of agents that railroads sometimes are afflicted with. There was an old gentleman at a way-station who was agent, and he owned the building that the station was located in and the right of way that the track ran through. His ideas of the duties of an agent were whatever he seemed to think might be right. He would not take instructions from any person except such as he himself thought, perhaps, were right. Oftentimes roads are very much annoyed by that class of men. There was a very large enterprise connected with this station which shipped a good deal of freight over the road. The shipper or consignee in receiving his freight would want to pay by check. The agent would not receive anything but cash—he must have cash. He afterwards got an order from the Treasurer that he should take the man's check. Well, the freights were settled in that way, until one day a shipper came up and the agent was digging his potatoes on the depot ground. The agent said: "Got a sack of flour in here for you; the charges are thirty-five cents." The shipper went to pay him the money and take his sack of flour, and the agent said: "I cannot take your money; I must have your check." He had the money with him, but he did not have his check-book. He was very anxious to take the

flour home with him; but he could not take it until he went two or three miles home, got his check-book, and wrote out his check and came back again.

Mr. TRATMAN ("Engineering News")—The platform question must be looked at from two points of view. I was about to speak in favor of raising the platforms rather than of lowering them, on account of the danger of stepping off trains in the dark in many places where there is no porter to put a step at the ordinary day cars. It seems to me that a platform rather higher above the rails than those now used would be better. As to the employment of station agents—if railroad managers would consider that they are the men who represent them to the public, there would be more care. I fully believe in having an inspection, and I also believe, with Mr. Berg, that the division superintendent should be in charge of this matter; but as to traffic and accounting matters, they should be handled direct between those departments and the agent. The rules usually set forth that the station agent must preserve order in and around the station, and keep the buildings and grounds in proper condition; but these agents are very apt to be careless in looking after the appearance of their surroundings, and as such men get more and more careless by becoming accustomed to dirt and disorder, it is a good plan to have station inspectors as a check upon them, to see that the waiting-rooms, toilet-rooms, closets, offices, store-rooms, etc., are kept in safe and sanitary condition, and that neatness is observed in the buildings and grounds. The town side of the station, with the approaches and surroundings, should be as well looked after as the railway side of the station, and a well-kept station with neat and cheerful approaches will help to maintain a more friendly relation between the railway company and its patrons and the municipal authorities. The station agent should see that the rooms and platforms are kept free from all old papers and other rubbish, and should do his best to prevent the use of the rooms as a common lounging place. There should be a can or bin for waste and rubbish, which should be emptied at intervals into a dirt car, and similar receptacles should be provided at yards or places where cars are cleaned. The yards, spaces between tracks, etc., at stations, should be neatly leveled and covered with ashes or gravel, and should be kept in order by the sectionmen; but strict rules should be made and enforced against the scattering of cinders from engine ash pans (which should be dumped at specified points), and against the sweeping of dirt and rubbish from cars or stations upon the track. The platform and floors should be kept in good repair, and the buildings, signs, mail cranes, etc., etc., well painted. A great aid in economically maintaining a good appearance is a car fitted up with air-brake pumps, and paint tanks for painting stations, fences, freight sheds, etc., and whitewashing cattle-guard fences, interiors of sheds, etc. The grounds at stations should be kept clean, tidy and free from rubbish. On some roads this work is delegated to the station agent, who has his men attend to it; while on other

roads it is part of the section-gang's work. The latter is the better plan if the force is sufficient; but the work should be done as directed by the roadmaster, as the station agent should not be given authority to employ the sectionmen for this purpose whenever he thinks proper. On large roads having a large passenger traffic, special care is sometimes taken, and lawns, flower-beds, etc., are laid out, the grounds being then sometimes attended to by a special force, which is included in the roadway department. It is specially important to have attractive grounds and pleasant surroundings at important stations, and at junctions where passengers may have to wait for connecting trains. At Moose Jaw, where the trains of the "Soo" Line connect with the Canadian Pacific transcontinental trains, the Canadian Pacific Railway has established a large flower-garden which is most pleasing to walk in and look at after the long hours in the car and the monotony of the prairie scenery. In all ordinary cases much may be done by section foremen and station agents who are not averse to spending a little time in improving the appearance of the station grounds, and a plot of turf, cinder or gravel pathways, a flower-bed, or a creeping plant on a building or a pile of rockwork, can be had with little trouble. An annual inspection of stations and station grounds, with a report upon their condition, and a system of rewards (in money or privileges), will be a great aid in getting station agents and others to give attention to cleanliness, neatness and appearance. At large stations and terminals there should be an ample force of porters and attendants to look after the convenience and requirements of passengers, and to keep the rooms and platforms in order. These men should be in charge of an officer, somewhat as in police service or the attendants of a large office building, and should be held strictly to the proper discharge of their duties. Only those who are civil and obliging in their manner should be retained in the service. They should be well informed as to train service, and know where to direct a passenger for any special information. American stations are notoriously deficient in their supply of porters to attend passengers between the street and the train, to carry the pasengers' hand-baggage while he is getting tickets, or to carry it from the train to a cab. The Union Station at Boston has some porters for this character of service; but there are not enough of them, and they are not as efficient or as alert as they should be. The New York Central Railroad advertises its "uniformed attendants" at the Grand Central Station: but these men are really of little use. These remarks apply also to smaller stations, where the passenger has to struggle with his own baggage and to seek for directions from the loungers and hackmen. The service of porters at English stations is admirable in many ways, and this system might well be adopted in a modified form in this country. It is sometimes argued that the system of checking baggage makes a porter service unnecessary in this country; but it is for the minor services noted above that these men are specially needed.

Mr. BERG (Lehigh Valley)—I desire to say briefly that when, during

the evening, several of the speakers have referred to the inspection that is given to local stations by superintendents, and referred to this inspection as being satisfactory, it can only be that the roads referred to are small, or else that the form of inspection is not considered essential or is not very strict. On any large important road the division superintendent certainly has no time nor the physical ability to visit the stations and make the detailed inspection. It therefore requires some special person to undertake this work. I fully realize the advantage of the personal contact of a division superintendent with the local agents referred to by one of the speakers this evening; but if it is impossible for the division superintendent to come in constant contact with these agents, then we had better have some one whose regular duty it is to attend to this branch of the service. I cannot illustrate this idea better than to say that this winter I was talking over this very subject with a division superintendent on an important railroad running to New York, and we took a tally of his work in the week previous to our conversation. For six days he had not really been engaged on his regular work at all. He was subpœnaed to court in a law-suit to give evidence; he went on a right-of-way expedition to give his opinion as to the valuation of some property; he was loaned to another railroad company as an expert railroad man to give some testimony, and he went over a new line of railroad that was to be built. There was this division superintendent for one week of his service really not in contact with what might be considered his regular line of work. This condition of affairs pratically goes on the entire year; so that really the division superintendent of an important road cannot possibly come into constant contact with the local station agent, so as to warrant making an inspection or a supervision, and therefore it is certainly necessary to have some one take this branch of the subject more particularly in hand.

Mr. McCOY (New York Central)—The division superintendent is assisted by an assistant superintendent or a trainmaster. They are on the immediate staff of the superintendent. Their duties are looking after the details, and I understand Mr. Haff to say he might want two or three assistants to help him look after the stations. Well, what are your assistant superintendent and trainmaster going to do? I have found no trouble at all in visiting the stations of our road as often as I believed it to be necessary, and in addition to that I have visited over one hundred signal towers. To an experienced eye it is not necessary to look around into every corner and nook in the building—one can see at a glance whether everything is all right. I do not believe in any set time of inspections—very often I used to go over the road at night. If you find anything at night that is not exactly right, make an example of the person you find at fault, and the other fellows would be looking for you for the next six months. They would not know when to look for you. The same way in your day inspection along the road—you can go without any set time and have no difficulty. I think the stations on the New York Central road will

compare favorably with the stations of any railroad that I know of. We have a system of inspection report that is in the form of a printed blank, which the trainmaster makes use of in checking things as he goes over the road, and everything that needs to be corrected he makes a note of. He speaks of it himself; or if it is of such a nature that the superintendent should know something about it, he brings it to his attention. I would be very slow to favor the appointment of a specially created superintendent ot stations to look after the station agents, and have the station agents report to him alone in all things that transpired at their stations. Why, it would be pretty hard to tell where the division superintendent came in and where the other fellow left off. There would be a conflict of authority at once; and it occurs to me that instead of trying to simplify matters, as one gentleman said, you would have simply created another boss for the agents.

Mr. HAFF—I think the gentleman who has just spoken must have misunderstood my reference to the necessity for assistants in the inspection work. We have on the Long Island road 350 or 375 miles of line, so situated that it is impossible for one man to go over this entire road in much less than a week. For instance, it would take one day on the main line, one day on the Montauk division, and the same on some of the other divisions of the road; and yet I find no difficulty in inspecting the entire line thoroughly every ten days or a week. I referred to a much larger territorial division than where I work. There, I urged, it might be absolutely necessary to have assistants. The question of platforms has been referred to by several gentlemen, and also insufficient lighting. Now, I am a crank on the lighting of the stations. I think we have the Long Island road lighted well from one end to the other, so that there is no danger of a passenger getting hurt about our stations. I would prefer spending money for lamps and oil instead of spending it in defense of accident suits. We have recently had the entire system of lighting remodeled, increasing the number of platform lamps considerably and placing all lamps on posts at a uniform height, in a direct line along the platform and at equal distances apart. We pay special attention to having agents keep globes clean and bright, and lamps regulated to go out after the passage of the last train at night. In order to keep up the best standard of service in this direction I find it necessary to ride a great deal nights, and I believe every careful superintendent will find it not only to his own advantage, but that of the company as well, to ride over the line at night as often as his work will permit. Promiscuous advertising in stations has been spoken of. We allow absolutely nothing of the kind. We have in each station a large blackboard or bulletin board, and on that we post every notice necessary to be posted by the company. We have a large card on the corner of the blackboard, on which we embody all special or standard notices. In regard to closets, we have very few stations where we maintain closets in the station. Nearly all of our stations have closets outside, which are locked

and a sign placed on the door ("Key with Agent"), and we insist on the agents keeping the closets locked. No loafing is allowed around our stations. Agents are very strict in that matter and absolutely stop it. Much can be done to improve the service by looking closely after the supplies used by the agent, especially in the way of stationery, station coal and oil. We have our agents make up a requisition on the first day of each month for such stationery as they will need during the current month only. We go over that requisition very carefully and see that it does not exceed the proper wants of the station. In the matter of station coal, we have it figured out so that we know just how much coal should be burned at each individual station to keep the station comfortably warm under ordinary circumstances. The bins hold enough coal to carry the agent through the winter, and we send our supply train to fill those bins at the beginning of the season and pay no more attention to it. Then, in the way of oil, we have a record of every lamp for which the agent supplies oil, including platform lamps, switch lamps and inside-burners. We have figured out exactly how much oil per hour each lamp burns, and we know how long they burn at each station. The matter of disinfectants at stations has been spoken of. In our closets we put chloride of lime and other disinfectants very freely, to keep them sweet at all times. The question of salary has been brought up. I do not know that I care to speak of that particularly, except to say that we do pay a fair salary; if we find the duties of the agents increase, and it is necessary, in order to keep the station running properly, to put additional help there, we do so. If we are not able to keep up the standard of the service for the salary, we increase it. We base the salary on the earnings of the station, keeping in mind the number of trains and the amount of work the agents has to do in all directions. By this system we preserve good-feeling among the men who are quick to recognize the fact that their rate of compensation depends upon the quality and quantity of service rendered.

Mr. WHEATLY (West Shore Railroad)—This has been one of the most interesting discussions recently had in the New York Railroad Club. It has been on a subject which is of a character that we have not discussed here since I have been a member. I am glad to have seen so many here and to know that the subject has created such interest. Although the gentleman who read the paper has limited his subject to local stations and has excluded the terminal station service, I just want to make one point, and to make it as briefly as possible, with regard to terminal stations and with particular reference to the handling of the freight traffic. No part of a railway system is of more importance than its principal terminals. The strength of a chain is measured by the strength of its weakest link. Likewise, the traffic capacity of a railroad is often measured by the capacity of its principal terminal for promptly disposing of the freight. If there is a weakness at the principal terminal it affects the whole line. The freight blockades that are of such frequent occurrence on many of our principal

lines indicate very clearly that the transportation facilities are in excess of the facilities for promptly disposing of the freight after it has arrived at destination. Evidently, we have not yet solved the problem of getting rid of the freight at our terminals as fast as it arrives. One of the difficulties encountered is that the flow of traffic is not continuous and constant, but is periodic; and it may be urged that railroads are not expected to provide for conditions that are only of occasional occurrence. If a business man disgraces himself and family by going on a spree once every year, and at the very time when he ought to be doing his best work, the fact that he remained sober the balance of the year will not be accepted as an extenuation of his offense. The railroad whose service becomes demoralized with every annual rush of business soon acquires a reputation for unreliability among its patrons that months of good service will not wholly remove. Whenever one of the principal terminals is crowded or, to use a common expression, is "blocked" by a periodic rush of freight, the resulting demoralization soon extends to the whole division, then to the whole road, and oftentimes to connecting lines. A blockade of freight has been described as a traffic indigestion. When a man's stomach is overloaded and he is suffering from dyspepsia, what is the remedy? It does not follow from his condition that he needs more stomach. The remedy is to stir up the system and arouse the stagnant organs to action. Sometimes the man may obtain temporary relief if he will stop eating; but no railroad cares to stop receiving freight, any more than the average man cares to stop eating. The chief thing for the division superintendent and the terminal agent to fight against is stagnation. Both the outbound and the inbound freight must be kept moving. More yard tracks and more warehouse room may ameliorate, but certainly will not entirely remedy the situation. When freight is kept moving it rapidly disappears and ceases to be a source of embarrassment. What we need most is not more track room to hold the waiting cars, not more warehouse room to hold the waiting freight, but such administrative measures as will prevent the cars and the freight from waiting. The business of railroads is not storage, but transportation. They should not be compelled to store freight in their cars or in their warehouses, from five days to five weeks, awaiting the convenience of their patrons to sell to the best advantage or to remove it at their pleasure. The present practice, which is solely in the interest of the shipping public, appears to be one of the weak points in our terminal station service which call for improvement. If storage facilities are required, they should be furnished by the parties who require them; or if furnished by the carriers, adequate compensation should be exacted from those who use them. In any event, freight cars should not be used for storage purposes. There are not many ways in which we can adapt the operating methods of roads in foreign lands to the needs of our own service, but certainly we may learn a useful lesson in terminal station service from our English cousins. British railroads offer to their patrons two rates—one of which is known as the "station-to-station"

rate, and the other as the "carted" rate. The railroads of Great Britain, like the express companies in the United States, do their own carting. They collect the goods at point of shipment and deliver them at destination, for which, of course, the rate is higher than the "station-to-station" rate. Nearly all merchandise traffic is handled under the "carted" rate, while minerals and grain are handled largely under the "station-to-station" rate. On all traffic handled under either rate there is a terminal charge in addition to the transportation charge; and when traffic billed at the "station-to-station" rate is not removed by the consignee within a reasonable time, it is placed in storage at his expense. I have been told that a very large proportion of the loaded cars arriving during the night at destination on the British railroads are unloaded by the following noon, and nearly all of them are made empty within twenty-four to forty-eight hours. The resulting economy appears in the fact that the time of transport from shipper to consignee is greatly minimized, the rolling stock and the terminal facilities are utilized to the very best advantage, and the traffic capacity of the lines is not weakened by the stagnation of freight at the terminals awaiting the convenience of consignee to remove it. At the International Railway Congress held last year in London, the following were the conclusions adopted after considering the question of cartage and delivery:

"The sending of goods through the stations and the delivery from house to house, when organized in a systematic manner, should be considered as one of the elements, properly so-called, essential to good working.

"If it is correct to state that the acceleration of goods (freight) traffic results in promoting a better use of the rolling stock and of stations, it is equally correct to affirm that a carting service, well organized and properly administered, or, better still, directed by the railway companies themselves, will give analogous and, to say the least, satisfactory results.

"The best system of obtaining an efficient cartage and delivery service in large towns consists in doing this work with their own teams. For towns of less importance a system of working by carrying agencies must be organized in accordance, as far as possible, with local conditions. It is fully recognized that free access to stations cannot be forbidden to private firms; but the organization of a system of working by means of companies' teams, and auxiliary collecting offices in the town, will possess the great advantage of meeting the requirements of the service, while giving the fullest necessary facilities to the public."

The practice described is in effect not only in Great Britain, but also in France and other countries on the continent of Europe. It is not my purpose to assert that the European cartage and delivery system can, or is likely to, be transplanted to American soil; I am not unmindful of some of the arguments that might be urged against its introduction into this country; but I believe the members of this club will agree with me in the belief that, if it were once in successful operation here, there would be much less heard about blockades of freight at our principal terminal

stations, and that our rolling stock and station facilities would be utilized to much better advantage. The system now in vogue of notifying the consignee by mail after the arrival of his freight at destination, and then awaiting his convenience to send after it or give orders for its disposition (the railroad company in the meantime furnishing storage free of charge), it seems to me, is unbusinesslike and should be abolished. The consignee always knows, or ought to know, that the freight is expected to arrive. If it is incumbent upon the carrier to give the consignee any notice whatever, would it not answer all reasonable requirements if the shipping agent who issues the bill of lading should, at the same time, mail a notice in prescribed form to consignee, giving him all the necessary information concerning the shipment? It should then be the duty of consignee to place orders with the agent at destination for the disposition of the property in advance of its arrival. A failure to do so should result in the property being stored at the owner's expense. These suggestions are offered not with the expectation that any of them are likely soon to be adopted, but merely for the purpose of calling attention to one feature of our terminal station service which is evidently susceptible of improvement, and to stir up a little useful discussion. Although the transportation department is the principal sufferer through the inadequacy of present methods of handling freight at our terminals, it appears that any reform on the lines suggested must come largely through the traffic department. Here, again, is an illustration of the fact, so often mentioned, that the successful and economical working of one department frequently depends upon the methods prevailing in a different department—all of which lends additional emphasis to the necessity of a more harmonious working of the several departments, if the best general results are to be obtained.

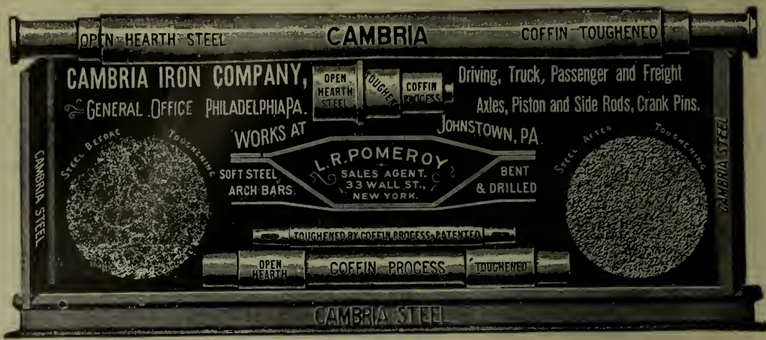
The PRESIDENT—The next in order is the Election of New Members.

The Secretary here read a list of the following names proposed for membership, and by vote the Secretary was directed to cast a deciding ballot for these fifty-three names, which was done: Wm. L. Beers, Neil Mooney, Geo. H. Higgins, W. H. Gomersall, Jr., Albert B. Taylor, Joseph B. Rood, H. D. Angevine, Wm. H. Corbett, D. M. Leish, W. F. Dorsey, W. H. Blood, A. P. Dennis, R. Atkinson, J. S. Coffin, R. C. Brown, F. M. Snyder, F. W. Everett, H. F. Baldwin, Ira A. McCormack, P. B. Wittmer, Wm. Burtis, J. W. Baugher, J. T. Mahl, Chas. L. Addison, L. S. Wells, Richard O'Sullivan, E. French, Leonard Goodwin, Wm. L. Clements, Geo. C. Martin, Jno. R. Alexander, Frank P. Hamilton, W. A. Steckel, R. L. O'Donnel, Chas. E. Gordy, Jno. E. Wright, S. J. Dillon, Robert H. Illingworth, F. H. Downer, A. M. Gamble, D. W. Hempstead, W. J. Crosby, R. E. Janney, Geo. W. Berrian, Wm. Lodge, Frank H. Newkirk, A. H. Purdy, A. W. Young, L. J. Boynton, Victor Belisle, W. S. Calhoun, Garrett Brodhead, E. W. Donahue.

The PRESIDENT—The next in order is Announcements. The topic

for discussion at our next meeting (May 21st) will be "Is It Good Practice to Use Blank Tires on Locomotives?" The discussion will be opened by Mr. L. E. Molineux, of the Lehigh Valley Railroad. Members are requested to come prepared to state what is their present practice with locomotives having six drivers, and with more than six drivers—what are the supposed advantages of blank drivers—are those advantages realized in practice.

On motion, the meeting adjourned at 11:10 P. M.



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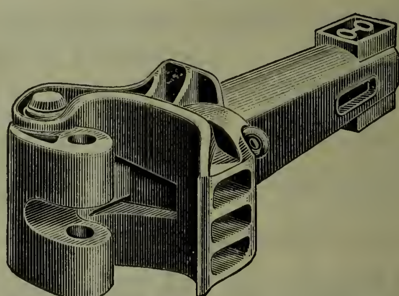

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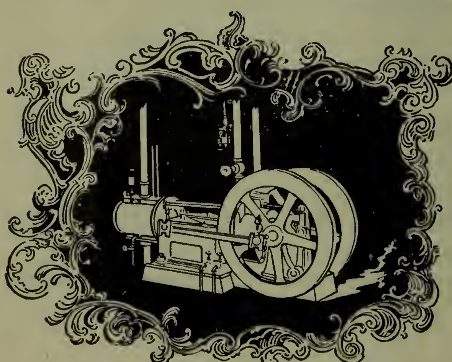

MEETING OF

MAY 21, 1896.

New York Railroad Club.

Subject: Is It Good Practice to Use Blank Drivers on Locomotives?

PUBLISHED BY THE CLUB.

W. W. WHEATLY, SECRETARY, FOOT WEST 42D ST., NEW YORK.

New York Railroad Club.

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Supt. of Motive Power, Erie Railroad.

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D. M. BRADY,
President, Brady Metal Company.

PROCEEDINGS

of the Meeting held at the Rooms of the American Society of Mechanical Engineers, 12 West Thirty-first Street, New York, on Thursday Evening, May 21, 1896.

Meeting called to order at 8:20 P. M. President West in the Chair.
The following members were present:

Wm. B. Albright,	William Burtis,	T. F. De Garmo,
Thos. Aldcorn,	J. E. Cromwell,	R. M. Dixon,
Geo. H. Baker,	F. J. Cole,	Geo. E. Dayton,
Stephen D. Barnett,	C. Christie,	A. L. Donnell,
D. M. Brady,	Fred. H. Colvin,	C. E. Douglass,
Garret Brodhead,	W. J. Crosby,	J. Donnelly,
Walter G. Berg,	John A. Covert,	F. D. Dates,
R. J. Bowers,	Wm. F. Casey,	Nat. C. Dean,
Geo. C. Bishop,	David R. Daly,	Geo. F. Evans,
J. B. Brady,	F. G. Dickson,	W. C. Ennis,
R. C. Blackall,	W. C. De Armond,	J. B. Ecclesine, Jr.,

H. A. Fergusson,
Geo. Fuller,
Geo. F. Flint,
W. C. Ford,
A. A. Fitzhugh,
Geo. A. Gardner,
H. J. Geriker,
R. L. Harris,
C. S. Henry,
F. E. Haff,
S. Higgins,
C. H. Hayward,
C. F. Hopkins,
A. W. Handy,
N. P. Hobart,
C. L. Hastings,
John A. Hill,
E. M. Hedley,
R. E. Janney,
H. E. Keeler,
F. S. Kent,
C. E. Leach,
Wm. Lodge,
W. H. Lewis,
Wm. E. Ludlam,
R. W. Martin,
L. E. Molineux,
Wm. C. Munroe,
J. H. Messinger,
J. F. Moore,
A. Major,
Geo. C. Morse,
A. E. Mitchell,
T. W. B. Middleton,
C. M. Mendenhall,
I. M. McCormack,
C. S. Mott,
F. E. Morse,
Geo. C. Martin,
Jas. Milliken,
E. P. Mallinson,
F. H. Newkirk,
R. A. Parke,
L. R. Pomeroy,
O. D. Pratt,
F. M. Patrick,
J. C. Peabody,
Seaton M. Scott,
Chas. Schlegel,
J. B. Stewart,
Cyrus L. Smith,
A. D. Sharpe,
M. P. Stevens,
J. H. Sewall,
L. M. Slack,
C. A. Smith,
Chas. Streisher,
F. M. Snyder,
Chas. B. Seabury,
J. E. Sague,
Angus Sinclair,
F. Tuma,
E. E. R. Tratman,
A. B. Taylor,
J. H. Turbush,
W. T. Thompson,
G. Thyberg,
H. H. Vreeland,
E. E. Vaniel,
G. Van Tassell,
J. H. Van Buskirk,
Geo. H. Waters,
W. W. Wheatly,
H. E. Williams,
Geo. W. West,
John E. Ward,
Harvey Walters,
W. B. Yereance;

Twelve Visitors.

The PRESIDENT—The next business is the Reading of the Minutes.

The Secretary then read the minutes, which were approved as read.

The PRESIDENT—The next in order is Reports of Committees. Mr. Wheatly, our Secretary, has a report from the Chairman of the Committee on Resolutions with regard to our late Secretary, which he would like to read:

The Secretary then read the following:

New York, May 21, 1896.

To the Members of the New York Railroad Club:

Your Committee appointed at the meeting of the Club on the 19th day of March, to prepare and to have engrossed a set of resolutions, expressing the sense of the Club for the loss they have sustained in the untimely death of its late Secretary, William G. Wattson, respectfully report that it has discharged that duty, and the resolutions appear in the printed proceedings of the meeting of the Club of that date.

The resolutions, as engrossed, are intended to show our appreciation of the man, and also a receord of his service while with us. We feel that what

we have done will be gratefully appreciated by his family, and we trust will meet with your cordial and hearty approval.

For the Committee,

C. W. Bradley,

Chairman

The PRESIDENT—The resolutions, gentlemen, as you see, are here against the blackboard. I am requested to state for the designer of the work that the frame you see on the resolutions now is not the one to be used finally for their framing. They intend to take the resolutions back to-morrow and put them in the proper frame. The Secretary also has a communication from Mrs. Wattson.

The SECRETARY—It is but proper to state that, by resolution of the Executive Committee, the salary for the entire year of the Secretary was presented to Mrs. Wattson, as a small token of the appreciation of the Club for Mr. Wattson's services as Secretary. This letter is in acknowledgment:

Haverstraw, N. Y., May 20, 1896.

Gentlemen—My pen can but faintly express my feelings in acknowledging the receipt of the generous gift, tendered through your Secretary, Mr. Wheatly.

This expression of your regard proves to me that my husband's character in life still remains a living presence in the hearts of his noble friends. For this tribute to him who has gone before, I beg you accept the heartfelt and grateful thanks of his children and of his heartbroken wife.

Very sincerely,

Annie G. Wattson.

The PRESIDENT—What is your pleasure, gentlemen, with regard to these letters from the Chairman of the Committee on Resolutions and Mrs. Wattson?

On motion of Mr. J. B. Stewart, which was duly seconded, the letters were received and ordered placed on the minutes.

The PRESIDENT—If there is nothing else under this head, we will pass to Unfinished Business.

Mr. MENDENHALL (Pennsylvania Railroad)—As the Chairman of the Committee of Twenty-one—so-called—to revise the Rules of Interchange, I would like to say to the Club that the Committee has concluded its labors, and the report has been submitted to the Arbitration Committee of the Master Car-Builders' Association. There were three meetings of the Committee necessary to complete this revision.

The PRESIDENT—Mr. Mendenhall, have you additional copies of these reports?

Mr. MENDENHALL—I was furnished with half a dozen copies of them, and brought four of them with me this afternoon. I have one, I see there is another, and I suppose the others are here.

The PRESIDENT—You refer simply to that portion of the Committee of Twenty-one, representing the New York Railroad Club?

Mr. MENDENHALL—Yes; Mr. Lentz, Mr. Thompson and myself.

The PRESIDENT—What is your pleasure?

Mr. MITCHELL (Erie Railroad)—I move that the Committee be discharged.

The motion was seconded and carried by unanimous vote.

The PRESIDENT—The next is Unfinished Business. Has any member anything to offer under the head of Unfinished Business? Has any member anything to offer under the head of New Business? The next in order, then, is Discussion upon Technical Subjects. Mr. Molineux, of the Lehigh Valley Railroad, has a paper prepared on the subject of Blank Tires on Locomotive Driving Wheels.

Mr. Molineux then read the following paper:

Is it Good Practice to Use Blank Drivers on Locomotives?

The flanged wheel is the mechanical contrivance that makes the present railroad of any kind possible.

Cable roads, electric roads, gravity roads, street railroads, are all run without locomotives, but all use the flanged wheel.

The Master Car-Builders' Rules for Interchange of Cars specify three classes of flange defects for which a car may be refused. This is strong evidence that a good flange is essential for safety. Certainly, then, there should be excellent reasons for omitting such a necessary contrivance on locomotive drivers, and the burden of proof should rather be with those that oppose the use of a flange on any driver than with those that would have all drivers flanged. Custom, however, seems to have reversed this in the case of certain classes of engines.

All eight-wheel engines now have four flanged drivers, but this has not always been the practice. A master mechanic, still in active service, tells me of an eight-wheel engine, used in 1857, having the forward drivers blank.

With engines having six drivers, three arrangements are now in use: 1st. Forward drivers blank, center and rear drivers flanged. 2d. Center drivers blank, forward and rear drivers flanged. 3d. All drivers flanged.

With engines having more than six drivers, a still greater number of arrangements of flanged and blank drivers have been tried; but as it is an innovation having all flanged tires on engines with more than four drivers, that which follows is limited to engines having a driving-wheel base of not more than 16 feet.

The present practice as to engines with six drivers is concisely stated in a letter from the Baldwin Locomotive Works, as follows: "It has been almost the universal rule in American practice, when three pairs of driving wheels are used under a locomotive, to make one pair with blank tires. In mogul engines the middle pair is made blank. In ten-wheel engines the middle pair is blank, if the swing truck is used under the front of the engine;

but if the truck has no swing bolster, and is only an ordinary swiveling truck, then the front driving wheels are made blank."

The advocates of blank drivers, and those of flanged drivers, will probably agree that on tangents the flanged tire is best; for it certainly is causing no extra friction, it improves the riding qualities of the engine, and, in the case of the derailment of the truck, the engine is more likely to remain on the track than if the forward drivers were blank.

If engines were always to run on tangents, the practice would probably be to use all flanged drivers, and there would be no subject for discussion.

The more curvature a road has, the more importance this question assumes, if, by using flanges on all drivers, some of the troubles from sharp flanges, uneven wear on tires and poor riding qualities of engines can be avoided.

The supposed advantages of blank drivers, as far as I have been able to learn them, are less strain on the track in passing around curves, the avoidance of flange friction on curves as to the pair of blank drivers, and less strain on the engine generally.

Those in charge of the track on the roads now using all flanged drivers, do not find that it is any harder on the track than if one pair of drivers were blank. Track as now built will stand strains, without injury, that would have been destructive in the past.

Certainly, all flange friction is avoided on the pair of blank drivers, but the tendency of the engine to travel in a straight line (that the flanges resist) is not destroyed, but only transferred to the flanges on the other drivers, causing them to do additional work.

Most builders of engines seem to favor blank drivers, probably believing that it is easier on the engine; but this hardly seems to be the case, as the riding qualities of an engine are certainly improved by using all flanged drivers.

There is really no danger of the track being too tight on account of curvature. If an engine having a 16-foot driving-wheel base could be placed on a 20-degree curve, with the three pairs of drivers in exact line and axles parallel, and the flanges of the forward and back drivers touching the outside rail, the flange of the center driver would be 1 and 5-16 inches away from the outside rail. According to the table, this would figure out a clearance of ¼ inch, as against a clearance of ⅜ inch on a tangent. This does not take into account any side play allowed in building an engine.

Gage of engine standing on tangent:

Distance between backs of drivers..........................	53⅜ inches.
Two flanges each 1⅜ inches....	2 6/8 "
Clearance	⅜ "
	56½ inches.
Standard gage 4 feet 8½ inches equals......................	56½ inches.

Gage of engine standing on a 20-degree curve, having a driving-wheel base of 16 feet:

Distance between backs of drivers	$53\frac{6}{16}$	inches.
Two flanges, each $1\frac{3}{8}$ inches	$2\frac{12}{16}$	"
Distance of flange of outside driver from outside rail, if drivers are parallel and in line—"Middle ordinate"	$1\frac{5}{16}$	"
Clearance	$\frac{4}{16}$	"
	$57\frac{11}{16}$	inches.
Standard gage, 4 feet $8\frac{1}{2}$ inches	$56\frac{8}{16}$	inches.
Widening of gage, account of 20-degree curve	$1\frac{3}{16}$	"
	$57\frac{11}{16}$	inches.

TABLE FOR WIDENING GAGE OF CURVES ON A ROAD USING ALL FLANGED DRIVERS UP TO A DRIVING-WHEEL BASE OF SIXTEEN FEET.

Degree of Curve.	Gage.	Degree of Curve.	Gage.
1 degree	4 feet $8\frac{9}{16}$ inches	11 degrees	4 feet 9 inches
2 "	4 " $8\frac{9}{16}$ "	12 "	4 " $9\frac{1}{16}$ "
3 "	4 " $8\frac{5}{8}$ "	13 "	4 " $9\frac{1}{8}$ "
4 "	4 " $8\frac{5}{8}$ "	14 "	4 " $9\frac{1}{4}$ "
5 "	4 " $8\frac{11}{16}$ "	15 "	4 " $9\frac{5}{16}$ "
6 "	4 " $8\frac{3}{4}$ "	16 "	4 " $9\frac{3}{8}$ "
7 "	4 " $8\frac{3}{4}$ "	17 "	4 " $9\frac{7}{16}$ "
8 "	4 " $8\frac{13}{16}$ "	18 "	4 " $9\frac{1}{2}$ "
9 "	4 " $8\frac{7}{8}$ "	19 "	4 " $9\frac{5}{8}$ "
10 "	4 " $8\frac{15}{16}$ "	20 "	4 " $9\frac{11}{16}$ "

NOTE—Not adhered to strictly on lighter curves. It is hardly necessary to widen gage on curves under 6 degrees.

Another road reports an additional clearance of $\frac{3}{16}$ inch for every 5 degrees of curvature.

Makers of locomotives, in their printed descriptions, rarely give any information as to flanged or blank tires; but it is of interest to note that, instead of using the term "rigid wheel base," they say "driving-wheel base," thereby showing that drivers are not expected to be in line and axles parallel in passing around curves.

One road represented here to-night mounts the tires on their consolidated engines as follows: Front tires, $53\frac{1}{8}$ inches; main tires, $53\frac{1}{4}$ inches ($\frac{1}{8}$ inch wider); third pair, 53 $\frac{3}{8}$ inches ($\frac{1}{8}$ inch wider); back pair, $53\frac{3}{8}$ inches. They give side motion between inside hub and box, on new work $\frac{1}{8}$ inch clearance, and have no trouble from sharp flanges. These engines pass nicely around a 23-degree curve in main line at a slow point, and around a 14-degree curve in main line which is not a slow point.

Some of the advantages of having all the drivers flanged are:

First—Fewer derailments: A blank driver can go in any direction without being lifted; whereas, one of a pair of flanged drivers, to leave the rail, except in cases of track spreading, must be lifted a height equal to the depth of the flange, and this tendency is opposed by at least half of the weight on the pair of drivers in question; consequently, the force to derail a pair of flanged drivers, in the first place, must be much greater than to derail a pair of blank drivers. In practice it has been found that fewer derailments occur with all flanged drivers.

As a natural consequence of this, the engineman feeling more confidence in his engine will, where high speeds are required, be far more likely to make his time than with blank drivers. Recently, in speaking to a former engineman, noted for fast running, who now holds the position of road foreman of engines, this point was strongly brought out, and he said that enginemen now making fast time in express service with ten-wheel engines, all drivers flanged, would feel, if placed on engines having one pair of blank drivers, such a lack of security that trains behind time would be the result.

Second—In a wreck much easier to replace on the rails, and take to the shop in a crippled condition:

Two examples will illustrate: A six-wheel switch engine, all flanged drivers, was pushing a freight train on a main line, when one of its rear drivers dropped off, due to defective axle. The rear axle was blocked up, and engine went to shop under her own steam. Had the center drivers been blank, this could not have been done.

A ten-wheel engine with forward drivers blank was wrecked, head-end and truck being destroyed. Crew started to take engine backward to the shop without a truck, and all went well until, on account of bridge repairs, the engine had to be run forward over a cross-over. Without truck, engine would not curve the cross-over. The blank drivers would drop off the rail every time an attempt was made. Pull the engine back, and the blank drivers would mount the rail readily. After repeated trials a truck was secured, and engine made the cross-over easily; but this caused a delay of several hours.

Third—A flanged tire is stronger than a blank one, and, being less liable to break, can be run longer: With one pair of blank tires and two pairs of flanged tires on an engine, when the blank tires are worn down to the safety limit, the four flanged ones have not yet reached the limit of safety, and this additional mileage of the flanged tires is not available as it would be if all tires were flanged.

Fourth—More mileage account, fewer sharp flanges: With all flanged drivers, the wear will be more nearly equal on all, and the full mileage of the tire is available. With center drivers blank, the forward drivers are liable to have sharp flanges, necessitating the turning down of all the drivers, to procure a safe flange for forward drivers. One of the most crooked roads in the country reports having much trouble with sharp flanges on forward

drivers, when their mogul engines had the center drivers blank, and their consolidated engines had the two center pairs of drivers blank. They frequently turned down an entire set of wheels from ½ to ⅝ of an inch in thickness, to procure safe forward flanges. All trouble from sharp flanges gradually disappeared when they commenced leaving flanges on blank drivers, as engines came into the shop for tire-turning. They now have full flanges on drivers originally blank, obtained from successive turnings, and report excellent results.

Another case to show excessive flange wear with blank drivers: On a ten-wheel engine with blank center drivers, used constantly in hauling cars up a steep grade in a yard with a heavy curve to the left, the forward right hand driver was found to have a sharp flange. The flange on the forward left-hand driver was good. Had the center drivers on the engine been flanged, the excessive flange friction on the forward right-hand driver would have been shared by the driver behind it, and a sharp flange avoided. It may be of interest to say that, in this case, the forward axle, with its drivers, was subsequently reversed. The forward right-hand driver, with its sharp flange, now had no flange wear, and worked well until its mate wheel was sharp, when the engine was shopped.

Fifth—First cost less: Engine tires are sold by the pound, the price being the same for flanged or blank ones. As blank tires are usually ordered from an inch to an inch and a half wider than flanged tires, they weigh more, and consequently cost more.

Sixth—Smaller stock of duplicate parts: A road using all flanged tires will have to keep but one kind of tires on hand, and only one style of driver brake shoe will be necessary.

Seventh—More tractive power: All tires wear hollow on that portion of the tread which travels on the head of the rail on a tangent. This hollow increases until $\frac{1}{32}$ inch deep, when tires are turned. Now, if one of the advantages of blank drivers (easier on curves) is experienced in practice, this hollow will be partly shifted to one side of the head of the rail in passing over curves; and the blank drivers will rest on one of these ridges on either side of the hollow, in which position it does not have a full bearing on the head of the rail, and is much more liable to slip than if it had a full bearing, causing loss of power at the very time when additional power is needed. With flanged tires, the wheel is kept in position so that each driver has a full bearing on head of rail, and the weight of the engine is more equally divided between each rail.

The PRESIDENT—The paper is now open for discussion. There are a goodly number of railroad men here to-night and I hope to have this matter thoroughly discussed. Mr. Lewis, won't you tell us your practice?

Mr. LEWIS (Delaware, Lackawanna & Western Railroad)—I would say that I was very highly entertained by that paper of Mr. Molineux'. That is just my experience exactly. I have not had a blind tire or plain tire on the road since 1872, and I do not think there is one on the Delaware.

Lackawanna & Western system. We never found any inconvenience from wear or cutting of flanges, or destruction of the railroad. I have never heard any complaints of it, and I believe it is the right system. We have four consolidation Baldwin engines, which were originally built with the first pair blind, second flanged, third blind and fourth flanged. We have gone to work and put flanges on all the tires, and have never had any trouble with them. It is as Mr. Molineux says—if by any accident the truck is knocked out, they are ready to go to the shop, and you have no further trouble with that. But we turn all our tires straight. We do not cone them with that class of engine, and we leave the leading pair about a quarter of an inch slack to the gage, second pair 3-16 inch, third pair 1/8 inch, and rear pair to gage, which is 4 feet 8½ inches. And then our six-wheel switch-engine drivers are all flanged. We leave the main driver up to gage, and the forward and back pair about 1/8 inch slack to the gage, so that they will go around curves readily. We do not have any trouble with cut flanges; but the tires are turned straight. Even on the wheels under the tender the tires are not coned. I do not know as to the experience of our neighbors. I would like to hear them on that subject. I know one thing, that when we did have some coned tires on engine truck it kept them in this lateral motion all the time, and we had to take them out and turn them straight. This has been our experience ever since 1872.

The PRESIDENT—We have with us to-night Mr. Medway, of the Fitchburgh Railroad. Won't you give us your views, Mr. Medway?

Mr. MEDWAY—Fifteen years ago I became impressed with the uselessness of blind tires on moguls and consolidation engines. A test was made at the time with two consolidation engines. One was equipped with all flanges; the other had the second and third pair blind. They were tried over a sharp curve. The engine with all the drivers flanged passed over without any difficulty whatever. Not so, however, with the one with the bald tires. As soon as the bald tires struck the sharp point of the curve they left the rail. Some time afterward I arranged three consolidation engines with all flanges, and the results were highly satisfactory. For the past two years we have not put on any bald tires at all, and we are more than satisfied with the results. It is a well-known fact that with mogul engines and consolidation engines using bald tires there is a tendency to cutting of the flanges. Now I have not found it so with engines with all flanges. The wear seems to be fairly in the center of the tread. That being the case, it seems to me that there must be less impingement, less wear and tear on the rail.

Mr. WEST—You have not found any rails turned over, have you, Mr. Medway?

Mr. MEDWAY—No.

Mr. BLACKALL (Delaware & Hudson Canal Railway)—We flange all wheels on our engines. I do not agree with Mr. Molineux about one thing. He says that the tire being blind, it is better on a tangent than it

would be on a curve. It is just the reverse of that. We have three consolidation engines running out of Binghamton, and we have no trouble with them going around curves; while the Erie have three or four in their yard—with the second and third pairs, I think, blank—that cannot go in our yard and turn around our curves. I think Mr. Mitchell will bear me out in that. We have no trouble with worn flanges. I would like very much to have our President state his ideas on the flange question.

Mr. WEST (New York, Ontario & Western Railway)—The President is a thorough convert to flanges on all wheels. The best proof I can give give you, gentlemen, of the advantage of all flanges, is to refer to a runaway on one of our mountain roads within the past few weeks, which you probably read about in the newspapers, where thirty-one out of thirty-four cars went down the bank. The engine was a consolidation, with flanges on all the wheels, and the third car from the engine was the one that left the track. Some who are advocates of bald tires said that the engine spread the rails. But it is evident that this could not have been the cause, for the reason that the three cars next to the engine remained on the rails. They were running just as fast as they could down an 80-foot grade, and the engine had tilted on either side so far that she had knocked off the pedestal braces on both sides; and that is one of the best proofs I can give you of the safety of the flanged tire. In 1890, when I went with the Ontario and Western, we had ten engines coming from the Rome Locomotive Works, 62-inch drivers, about 120,000-pound moguls. We were unable to get over six months' wear out of the tire without turning it, and we finally resorted to ordering tires especially for the front wheels. At that time we were getting some engines built at the Dickson Works, and I visited the Delaware, Lackawanna & Western shops. Mr. Graham was master mechanic then, and I called his attention to the perfect flanges on all of his engines, and he gave as the reason the fact that he was using all flanged tires. He said he at one time used blind tires, and as soon as he commenced using them he had sharp flanges; and he then instructed his lathe-man to turn back just as far as the rail wear was, and to his surprise, at the time the tire was worn out, he had perfect flanges. On my return to our shops, I instructed our tire-man to do the same thing on one of the Rome engines. This was done, and the engine left the shop and was assigned to a division farthest from my office. I was out on that part of the road a while afterwards and the engineman said to me: "What did you do to this engine when she was in the shop?" I had forgotten all about the instructions I had given about turning the tire. He said the engine rode so much better. When I came back to Middletown I asked the foreman in charge about it, and he said: "Why, that is the engine you ordered the flange turned on the middle driver, turning it back so that it took off just beyond the wear of the rail and left a ⅝-inch flange." From that time we continued leaving the flanges, on turning them back, just as far as the tread was worn, and to-day we never take an engine in for turning-tire account

of sharp flanges. I would also add that one of our most reliable engineers said to me within thirty days, that formerly, when running our engines with bald tires, he had often gone out to the front of the engine and held the oil-can over the wheel flange where the fire was flying out of the pony truck wheels. We run these engines now on the fastest milk trains, and do not have to use an oil-can.

Mr. McCORMICK (Brooklyn Heights Railway)—I am in the electric railroad business, but I am very much interested in the paper read to-night. I have had twenty-five years' experience on steam railroads; and while I cannot go into a discussion of the merits of the question from a technical standpoint, I have had considerable personal experience riding on engines that have had flanges on all the drivers, and on those that did not have all the drivers flanged; and I believe if there is any gentleman here connected with the Baltimore & Ohio Railroad, he can tell us of eight-wheel engines running on their express trains that have only the rear drivers flanged. I think they are running on the Pittsburgh division on their fast trains. In the paper read I think it was stated that there were none known at the present time. I was with the Lake Shore road during the World's Fair, and we had five large eight-wheel engines built to run that "Exposition Flyer," and riding on that engine, and taking curves, you would get such a jar on that eight-wheel engine that it was a hard matter to keep your seat. When we put the ten-wheelers on with the forward drivers having no flange, you would get no shock of that kind. There is something in that that might be brought out.

Mr. MITCHELL (Erie Railroad)—Our practice, on consolidation locomotives, is to flange the forward drivers and the rear drivers, leaving the second and third pair plain. We use 5¾-inch tire for the forward and rear tires, and 6½-inch for the plain. On a sharp curve we have had an engine leave the track—I presume one of those curves Mr. Blackall was talking about—but we very rarely have an engine leave the track on main line and these engines are running as high as 50 miles an hour. We have ten-wheels making as high as 70 miles an hour in places, with the middle pair of wheels plain. We did have a few with a rigid truck with the front pair plain; but we have changed such engines and applied a swing motion truck, and made the middle pair of drivers plain in order to get an easier-riding engine. I do not believe that an engineer will make better time with a locomotive with all tires flanged than he would with the middle pair plain, as stated by the gentleman who read the paper. I consider our engines perfectly safe to make any speed, provided the driving wheels are the proper diameter for the speed. Speaking about eight-wheel engines, I was talking with a superintendent of motive power to-day in my office, and he stated that all their eight-wheel engines had the forward drivers plain. Those engines were run on their fast trains. They use a rigid truck, and a 7½-inch tire in width on the main wheel, and are getting exceedingly good results from that practice. The gentleman who read the paper also

stated that the term " driving-wheel base" was used in place of "rigid wheel base" on account of the axles not remaining parallel. I wish to take exception to that remark. I do not believe that any of us are running locomotives with the axles out of parallel. If we are, I think we had better shop the engines soon as possible. I do not fully agree with the previous speakers on the sharp flanges being formed by using plain tires on the engines. We make a large mileage without having sharp flanges. An engine must be shopped when the tires are worn ¼ of an inch with us, and we have a great many engines shopped that do not have sharp flanges—engines of the consolidation and ten wheel types. Again, I do not agree that the tractive power is greater with all the drivers flanged than where they are not. The wear of the tire is gradual. The space on the tires worn by the rail is not exactly the size of the rail, and therefore a locomotive running on a curve will surely have a good solid bearing with each wheel on that rail. The tractive power must be therefore the same. I am open to conviction, I will say candidly, on the question of putting more flanges on our wheels. It is under discussion with us, and we have not yet decided whether to add more flanges or not. I am of the opinion, however, that we will get better results if we put flanges on three wheels (and possibly on all four) of the consolidation engines.

Mr. SINCLAIR (Editor "Locomotive Engineering)—I have been much interested in the paper read. I think it was a remarkably good defence of the practice of putting flanges on all wheels. I was surprised to hear the gentleman speak of the engines running about 1867 or thereabouts —eight-wheel engines, without flanges on the front tires—for I am aware that there are a good many that are running that way to-day, and it is only a very few years ago when most of the eight-wheel engines of the New Haven road had blind tires in front. I am aware that these engines were changed, not on account of excessive flange wear, but from excessive side wear. The subject has been up for discussion very frequently at the Master Mechanics' Association for ten years back (I think about every second year, if I remember rightly), and it is remarkable to find how gradually the members have been changing in favor of flanged tires. When the discussion was up first it seemed that the bald tires were very largely in favor, but by degrees they got to be less popular. One year a party would strongly advocate blind tires, and then he would perhaps find so much trouble from hub wear that he would put flanges upon all tires, and so it has come about that when they had another discussion on the subject he would not favor the blind tire. When they had the last discussion on the subject there were very few that advocated blind tires, and now, to-night, our sworn defender of them, Mr. Mitchell, seems to be convinced that he had better come to the prevailing fashion. I think that the idea of the advantages of the bald tire arose from an abstract theory, just the same as the theory of the advantages of a coned wheel. One could figure on paper a great many advantages for the bald tire and a great many advantages for the coned wheel, but I am convinced

that in practice the theory does not work well. After all, however one might theorize upon any engineering subject, if it is not borne out by good practice it is not going to last long.

The PRESIDENT—Mr. Sague, what is the general practice in your shops in building for the railroads?

Mr. SAGUE (Schenectady Locomotive Works)—Our general practice is to put on blind tires on the middle connections of ten-wheel and mogul engines, and blind tires on the second and third pair of drivers of consolidation and 12-wheel engines; but, of course, in regard to the arrangement of tires on all engines that we build, the superintendents of motive power of the different railroads include the specifications of the tires almost invariably in their specifications, and my statement would only indicate the prevailing practice of the superintendents of motive power on that subject. We are not convinced as to which is the better practice to recommend. For our own part, though, we are gradually coming to the idea that the more flanges you have the better; and the experiences we have heard from the engines built by us for the Fitchburgh Railroad, and also for the Delaware & Hudson Canal Company, have had a good deal to do with the forming of that opinion. There is one thing I can say quite conclusively, and that is—we have made up our minds that it is a good deal better plan to have the blind tires for the ten-wheel engines on the middle rather than on the forward drivers. I think we may be a little undecided as to whether blind tires should be used, and we are thoroughly decided that if they are used on the ten-wheel engines, they should be on the middle rather than on the forward wheels.

A MEMBER—I would like to ask Mr. Sague to explain why he would have the blind tires on the middle wheels rather than on the forward ones.

Mr. SAGUE—We feel as if it is safer to have three flanges at the head of the engine than two; and we feel also, from observation on different railroads, that the blind tire is a prolific source of hub wear. I have found in practice on the railroad, and also since being in the locomotive works, that engines having blind tires on the forward pair are more apt to have hub wear on the forward truck, and also on the flanged drivers, and I think the reason is quite clear. Take it on straight track: If all the wheels are flanged, and a reasonable amount of lateral motion allowed, the flanges keep the wheels in line; while if one pair of tires is blind, the only thing which keeps those tires on the track is the pressure due to the driving boxes. There are no flanges; consequently, the driving boxes have to maintain those wheels in alignment. We notice, in the case of a ten-wheel engine with rigid center truck, that the rigid wheel base is from the center of the forward truck to the back pair of driving wheels, being more properly that dimension than the driving wheel base, as generally stated, and consequently we think, by putting on a swing center forward truck and giving them a flanged pair of driving wheels forward, that we shorten up the rigid wheel base rather than lengthen it.

Mr. WEST (New York, Ontario & Western Railway)—Mr. Sague's

remarks suggest one point referred to by Mr. Mitchell. You will find in the case of bald tires that they will be worn an inch and a half off the center of the tread, while you never find this on flanged wheels. I know when we commenced using bald tires we soon found them worn an inch and a half off the center. Now, that must necessarily be harder on the track than where the wear is even, and I think the same experience would be true of every road. You find the rail has worn into the bald tire off the center, and you seldom see that on flanged wheels.

A MEMBER—Mr. Mitchell seems to think that he cannot get any better adhesion with flanged tire than with bald tire. Now, going around a curve, it must be seen that the tire on the outer rail will go towards the inside of the rail, and on the other side towards the outside of the inner rail, and consequently they must have less contact on the rails.

Mr. WEST—I think so, too.

Mr. BLACKALL (Delaware & Hudson Canal Railway)—I am of the opinion that the gage of the track has considerable to do with the matter. The chief engineer of the Delaware & Hudson gives a clearance of three-sixteenths of an inch wide of gage to every five degrees of curvature. I remember some years ago, at one of our Master Mechanics' Conventions, Mr. Cloud, who was then engineer of tests on the Pennsylvania Railroad, made a statement bearing upon this point. He said that they had changed the gage of their road from 4 feet 9 inches to 4 feet 8½ inches, and the locomotive engineers saw no difference in the pulling of trains until they came to a curve. I asked him how he set the gage of the track on curves, and he said the same as on straight line.

Mr. MARTIN—Formerly I was connected with the Philadelphia, Wilmington & Baltimore. As late as 1881 every engine on the road was equipped with bald tires on the front wheels. About that time the road passed into the hands of the Pennsylvania Railroad Company, and as their practice was all flanged tires, the engines were gradually changed; and having had immediate charge of the repairs of locomotives, I cannot say that I think there was any decided advantage in the change. There was no less and no more flange wear due to the bald tires. I do not think that the engineers were at all afraid to run their engines at as high a speed as they would go. The road was always noted for good speed, and the engines always did good work. From the maintenance-of-way standpoint, I think the change was a good one. Every curve on the road, except possibly those on the main line, had to be equipped with guard-rails. An engine on a sharp curve without a guard-rail was liable to go off the track, and many times that was a very decided disadvantage, as guard-rails were not always kept up in as good shape as they ought to be, and the consequence was that engines quite often got off the track. After flanges were put on all tires, of course, these guard-rails were taken up and the engines could go anywhere. I do not think there was any more flange wear, nor any more wear on the boxes, with the bald tires. My recollection is now that the change did not make

any particular difference as to that. I remember one case of which I was a very much interested spectator, where I think the flanged tires would have been a very decided advantage. We were running an express train engine equipped with bald tires on the front wheels. It was a very warm day in summer, and the rails had expanded so that there was a very sharp bend in the track. The bald tires dropped off at the bend and ran alongside of the rails some distance before the train was stopped, while four or five cars passed over the "V" in the track without being derailed. If all the drivers had been equipped with the flanged tire, this would not have happened to the engine. The consequences in that case were not serious, but if the train had been running at high speed they might have been. I think, on all accounts, it is the best practice to use all flanges on eight-wheel engines. With ten-wheel and consolidation engines I have not had enough experience to be able to give an opinion that would be of any value.

Mr. MENDENHALL—(Pennsylvania Railroad)—I do not know that I can add anything to the discussion. We are not generally using locomotives of the consolidated or mogul types on the Philadelphia, Wilmington & Baltimore Railroad.

Mr. POMEROY (Cambria Iron Co.)—Mr. President, you stated, I believe, with regard to those Rome engines, that they had bald tire forward. and it had to be turned every six months?

Mr. WEST (New York, Ontario & Western Railway)—Not the forward tire bald; the middle tire bald.

Mr. POMEROY—You did not state how long you kept them out.

Mr. WEST—Until the tires needed turning on the entire set. I would state further that we left the maximum gage 4 feet 5½ inches for the middle pair on the mogul, and the two center pairs on the consolidation, and the front and back ones the minimum of 4 feet 5¼ inches.

Mr. MITCHELL (Erie Railroad)—The general opinion seems to prevail here that the flanged tire has the majority; but I guess if you drop the Fitchburgh, the Delaware, Lackawanna & Western and the Delaware & Hudson, you have nothing left. I guess all the others have the bald tires in the middle.

The PRESIDENT—Mr. Mitchell, I would be glad to have you work up some blind-tire advocates. While we seem to be on the other side, we are, like yourself, open to conviction.

Mr. MITCHELL—I was hoping that Mr. Mendenhall would give the Pennsylvania practice. I notice that his engines have two and three bald or plain tires, the same as ours. Perhaps Mr. Mendenhall can give us the Pennsylvania practice?

Mr. MENDENHALL—The practice of the Pennsylvania Railroad Company is to use blind tires on the second and third pairs of drivers on their consolidation locomotives, and the best evidence that that practice is thoroughly believed in is the fact that all of these engines are so equipped and that there are a great number of them.

The PRESIDENT—How about the Metropolitan Traction Co., Mr. Vreeland? (Laughter.)

Mr. VREELAND—Mr. President, I don't see why the Rip Van Winkle of the steam railroads should be called upon to wake up and talk on this proposition; but while I am Rip Van Winkle on the steam railroad, I am away ahead of you on up-to-date appliances and equipment. We run on four wheels, and they are all flanged. My experience with bald tires dates back about twenty years. I was a brakeman then on a fast mail train; and. together with the rear brakeman, engineer and baggageman, my railroad experience was limited by the mileage of the system we were on. We had a conductor who had had experience on other lines, and he had fallen accordingly in our estimation as a railroad man. We only had eight-wheel engines. We were at the end of the line one day, lying over for some hours, and some question came up about an engine with a broken flange taking her train in, and we could not see how it was done. The conductor spoke up and said he knew a road that had switch engines, and some of the drivers did not have any flanges at all. You may know where that man sank to in our estimation. We sat there an hour and argued that it was preposterous. Shortly after this, however, they put on some fast express trains, to run which they had ordered some mogul engines. These engines had some bald tires. The first one to go out upon the line, after being broken in, ran a train for the general passenger agents, taking them to their convention. I was one of the brakemen on that train. We brakemen sat down and talked the matter over. We were not going to take any chances, and we stalled that train on the first curve we came to; but when we saw that it stayed on the track, we let it go around that curve, and we found she went all right around other curves, and before we got back we were satisfied to run just as fast as the engineer wanted to go. Since that I have been connected with roads that have used the bald tire, and I found that they stayed on the track—and on a crooked road, too. That is my experience with bald tires.

The PRESIDENT—I do not want to close this meeting as long as anyone has something to say.

Mr. ALDCORN—I have nothing to say—only I am a convert to flanges on all tires.

Mr. MOLINEUX—Mr. President, I would say that the Lehigh Valley use flanged tires entirely.

Mr. MITCHELL—I would like to hear from some one with regard to track wear.

Mr. DONNELLY (Lehigh Valley Railroad)—I do not know that I am competent to discuss the matter except from the operating standpoint, but from that point of view I am in favor of all wheels under locomotives being flanged. While I have had experience with both, and we have never had a derailment on the main line that could be attributed to a bald tire, we have had them in the yards—and possibly in the old times, when it was not

customary to flange the front pair of drivers of a passenger engine, and tracks were not up to standard gage, we may have had them on main line. For an all-round locomotive that you want to use anywhere, I believe in having the wheels all flanged. We now have eight-wheel coupled engines with 4 wheel trucks running around curves that twenty years ago we did not have anything running around. I am not certain that all our locomotives have all their wheels flanged; but where they come into the shop and need new tires, none but flanged tires are used. I think Mr. Higgins is here and can tell us all about it. From a maintenance-of-way point of view, I do not believe there is any data to tell what is most desirable. On a road which uses all flanged tires they get no data about flat tires, and on roads where both are in use they cannot tell which damages the track the most. Our practice is to widen the gage of very short curves about ½ inch, to enable long coupled engines to go around. With regard to the wear on the engines or driving wheels, that is a mechanical question I am not capable of discussing. I can only say that our master mechanic tells me that the hub wear on a plain-tired wheel is much greater than it is on a flange-tired one. I have known ten-wheel engines where the middle pair of drivers, not flanged, dropped inside the curve and the others remained on the track. That, of course, is not a common thing, and is only likely to occur in a yard where the tracks have spread an inch or more wider than the gage. If Mr. Higgins is here he can tell us more on the mechanical question. He came with me and expected to be here to speak for himself.

Mr. MITCHELL (Erie Railroad)—Mr. Donnelly says they widen their gage a half inch on curves, if I remember rightly; and also said that on twenty-degree curves, with 16 feet rigid base, it was necessary to widen the gage 1$\frac{3}{16}$ in order to get the engine around

Mr. MOLINEUX—I think Mr. Donnelly stated on light curves; that is, if you allowed nothing for the play of the engine. I have a letter here from the roadmaster of a system with over 1,300 miles of track and over 700 locomotives, in which he says: "As far as my experience now goes, engines with three pair of driving wheels all flanged are not any harder laterally on our track than if one pair was blank. Derailments of this class of engines have occurred where one of the wheels (either the front or middle one) was blank. As I now look at this question, I see no objection to having all the driving wheels of engines of this class flanged, and they are not injurious to the track, when so arranged, when run on curves having a radius of not less than 300 feet."

Mr. MITCHELL—Is that from a maintenance-of-way man?

Mr. MOLINEUX—That is from a roadmaster, and his standard for widening on curves is 4 feet 9$\frac{11}{16}$ inches.

Mr. STEWART (West Shore Railroad)—This seems to be a question for the mechanical department to decide. They are not agreed, and, of course, they would not take an opinion from a man in the operating department. In regard to the question of the traction of the driving wheels,

an instance occurred on the west end of our road not long ago. Our limited train lost time between Rochester and Chili Junction, where we run over the New York Central tracks, the engine slipping all the way, and they could not account for it. The next day they made an investigation to see if anybody had soaped the rails, or what the trouble was. They found the engine tires worn very nearly ¼ of an inch. The New York Central had put down their 90-pound rail with wide head the day before, and the rail being wider than the worn space in the tires, the lattter were riding only on the outside edge of the rail. It seems to me that illustrates some of the ideas brought out here to-night. If there is much hub wear, why that wheel is going to slip over more and give less wear. It won't touch both sides at the same time.

The PRESIDENT—I was reading in the proceedings of the Master Mechanics' Convention for 1895 that some point was brought out in discussing the matter of flanged wheels. It was stated that they had found engines with bald tires where the men had been a little careless in oiling them, and the oil had run down the spokes and over onto the tread of the wheel, where with flanged tires it would not occur.

Mr. BERG (Lehigh Valley Railroad)—The discussion this evening has gradually drifted to a branch of the subject that I have had in mind, viz., the influence of locomotives in damaging track. It seems to me that the subject of the influence on the track should receive co-ordinate consideration in this discussion with the influence of blind or flanged tires on the locomotive itself. It is a question also that has been touched upon by Mr. Blackall, whether the motive power men give proper consideration to the question whether at the time that they take the observations on the improved conditions of the flange wear they consider whether some regulation has not been introduced in the track service, the maintenance-of-way service, relative to opening the gages on curves or extra bracing of the rails on curves, which influences this subject, and perhaps had also something to do with diminishing the flange wear. As already mentioned this evening, I do not think we have any reliable information on this subject of what damage is, perhaps, done to the track by one or the other of the driving wheels, but I think the question should receive co-ordinate consideration in looking into it. The rules for opening up the gage probably vary on the different roads, and will vary on some other roads according to different views that exist and progress that has been made in the different ideas on the subject.

Mr. POMEROY (Cambria Iron Co.)—Recalling the remarks made by Mr. Sinclair in connection with the discussion on the subject at the conventions, a little incident came to my mind. There were a number of gentlemen, and, in speaking of this subject, one gentleman became very emphatic against the use of all flanged tires. I spoke up and said: "Have you had any experience with engines with all the wheels flanged?" I found that he had never had any experience with engines with all wheels flanged, except

switch engines; and perhaps that has something to do with the opinions expressed here.

Mr. ALDCORN—One little instance came to my mind while Mr. Pomeroy was speaking. Some years ago we had an eight-driver switching engine, with the middle pair of wheels bald, and with a short wheel base. But we took that engine away and put in the yard a six-wheel switching engine with all the wheels flanged. The foreman in charge of that track found a good deal of fault; but I know we never put a light engine in there again, and I never heard of any damage done to the track any more than before.

Mr. MITCHELL (Erie Railroad)—I have, of course, to stand up for my side and offset what Mr. Pomeroy has said. We originally did have the first, third and fourth drivers flanged. Before I took charge, for some reason, they changed that practice and made No. 3 driver plain, putting on 6½-inch tire. That practice prevails on the Erie to-day, when formerly there was one extra wheel flange.

The PRESIDENT—I wish Mr. Mitchell would tell the rest of that story.

Mr. MITCHELL—I don't know the rest of it.

The PRESIDENT—I was master mechanic at that time on the Erie, and had orders to turn off the flange of the third pair of drivers which Mr. Mitchell speaks of. The engines were changed from one division to another, and one of the first engines sent over dropped in between the rails, and kept dropping these wheels off and that is why the 6½-inch tires were applied.

Mr. BLACKALL (Delaware & Hudson Canal Railway)—I would not like to have the meeting close without extending to Mr. Mitchell an invitation to come to Binghamton and run his engines around those curves I spoke of. If he will do this he will be converted. (Laughter.)

A MEMBER—I think Mr. Mitchell is the only one left on that side of the question. I think we had better leave it open until next fall, and appoint Mr. Mitchell a Committee of One to flange some engines and try them and report.

Mr. E. E. RUSSELL TRATMAN ("Engineering News")—The practice in the use of blank tires on driving wheels is very varied, as shown by the accompanying list, which may be summarized as follows:

Of five mogul engines, one has flanged tires on all the driving wheels, while four have blank tires on the second pair.

Of sixteen ten-wheel engines, eleven have blank tires on the first pair of driving wheels, and five have them on the second pair. With blank tires on the first pair, the rigid wheel base is the same as on an eight-wheel engine.

Of nine consolidation engines, five have blank tires on the second and third pair of driving wheels, two have them on the second pair only, one has them on the third pair only, and one has them on the second and fourth pair.

Of three twelve-wheel engines, two have blank tires on the second and third pair of driving wheels (one of these engines having them on the main drivers), and one has them on the second and third pair, the second pair being the main drivers and having flanged tires. The decapod engines of the Erie Railroad have blank tires on the second and third pairs of driving wheels.

The only road I know of on which blank tires have been used for eight-wheel engines is the New York, New Haven & Hartford Railroad; but I believe the practice has long been abandoned on that road, after some derailments which were attributed to these tires.

Blank tires are not much used in European practice. The St. Gothard Railway has ten-wheel engines with flanged tires on all driving wheels, and a wheel base of 11 feet 6 inches. The Highland Railway, of Scotland, has ten-wheel engines with blank tires on the second (main) pair of driving wheels, and a wheel base of 13 feet 3 inches. The Paris, Lyons & Mediterranean Railway has consolidation engines (without truck) with flanged tires on all driving wheels, and a wheel base of 18 feet 9 inches. The London & Northwestern Railway has similar engines with all tires flanged, and a wheel base of 17 feet 3 inches, the two end axles having ½ inch extra lateral play.

It would be of interest if we could know the reasons for the adoption of the various arrangements of wheels with blank and flanged tires, and what relation these arrangements bear to the alignment of track, the flange wear of the tires and the train resistance. If any road has any one type of engine fitted with two arrangements of the blank and flanged tires, it would be interesting if we could know what are the comparative results in the three items mentioned above. Where blank tires are used it seems to me that the brake-shoe should have a bearing on the full width of the tires, so as to dress them down and prevent hollow or false flanged tires. I would like to ask if there is any special objection to the use of blank tires on the main driving wheels?

Mogul Engines (Three Pair of Driving Wheels).

	Driving Wheel Base. ft. in.	Blank Tires.
Erie & Wyom. Valley Ry....................	14 0	None.
Baldwin Loco. Works (Colum. Expos., 1893).	......	2d pair.
Great Northern Ry..........................	......	2d "
Col., Hock. Valley & Tol. Ry.	......	2d "
Mo., Kan. & Tex. Ry........................	12 8	2d "

Ten-Wheel Engines (Three Pair of Driving Wheels).

	Driving Wheel Base. ft. in.	Blank Tires.
Baldwin (Columbian Exposition).	......	2d pair.
Baltimore & Ohio " " .	.....	1st "
B. & O. Southwestern " " .	......	2d "
Charl. & Sav. " " .	......	2d "
Cooke Loco. Works " " ..	......	1st "
Lake S. & M. So. " " .	..... .	1st "
Great Northern " " .	......	2d "
Terre Haute & Indiana " " .	......	1st "
Cin., Ham. & D. " " .	......	1st "
Chicago & N. W. " " .	14 11	1st "
Cin., Mil. & St. Paul " " .	13 6	2d "
Chesapeake & Ohio.................	11 10	1st "
Erie.....................................	12 0	1st "
Southern Pacific....	12 2	1st "
N. Y., C. & St. L.....	14 0	1st "
Mexican National (narrow gage).	......	1st "
St. Gothard (Switzerland)........	11 6	None.
Highland (Scotland), second pair main.... .	13 3	2d pair.

Consolidation Engines (Four Pair of Driving Wheels).

	Driving Wheel Base. ft. in.	Blank Tires.
Phila.. Read. & N. England.................	14 0	2d and 3d pair.
Pittsburg Junction...............	14 0	3d "
N. Y.. N. H. & H...................	15 0	2d " 4th "
Norfolk & Western (Columbian Exposition).	.....	2d " 3d "
Illinois Central " " .	......	2d "
Chesapeake & Ohio " " .	......	2d "
Great Northern " " .	......	2d " 3d "
Missouri & Moline " " .	14 0	2d " 3d "
M., St. P. & S. S. M. " " .	......	2d " 3d "
Paris, Lyons & Mediterranean (France)	18 9	None.
London & Northwestern (England)........ ..	17 3	"

Twelve-Wheel Engines (Four Pair of Driving Wheels).

	Driving Wheel Base. ft. in.	Blank Tires.
Southern Pacific (second pair main drivers)...	15 6	2d and 3d pair.
Great Northern " " " " ...	......	1st " 3d "
Dul. & I. Range...........................	15 6	2d " 3d "

Decapod Engine (Five Pair of Driving Wheels).

	Driving Wheel Base ft. in.	Blank Tires.
Erie R. R...................................	18 10	2d and 3d pair.

The PRESIDENT—The next business is the election of new members.

The Secretary then read the following list of names, which had been approved by the Executive Committee. The Secretary was directed to cast a deciding ballot in favor of them, which he did.

Wm. E. Banks,	Geo. E. Fisher,	Wm. H. McConkey,
R. H. Blackall,	Chas. W. Gennet, Jr.,	F. E. Morse,
James Churchward,	W. C. Hartigan,	Geo. F. Morse,
Dean Clark,	S. D. Hutchins,	E. F. Slocum,
R. C. Edwards,	C. E. Lambert,	Augustus C. Thomae,
	C. S. Lee,	

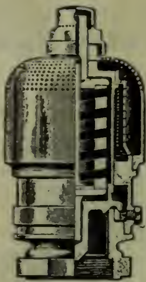
On motion, the meeting adjourned about 10 p. m.

Lunch was served.

ANNOUNCEMENT.

The next meeting will be held on Thursday Evening, September 17th, 1896, at the usual place.

In order that the scope of the Club's influence may be extended, each member is requested to interest himself during the next few months in bringing in desirable new members. Blanks will be furnished by the Secretary upon application.



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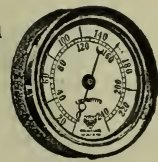

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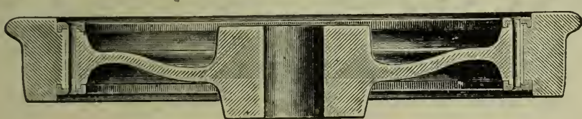

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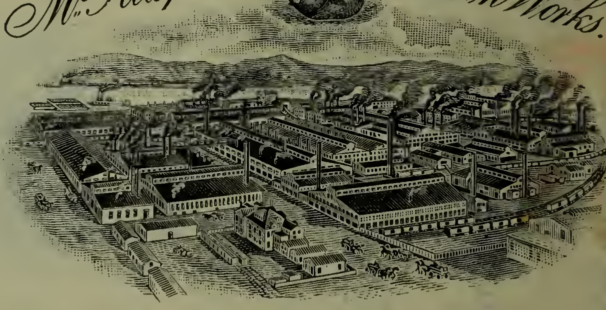

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MEETING OF SEPTEMBER 17, 1896.

New York Railroad Club.

Subject: The Effect of High Rates of Combustion Upon the Efficiency of Locomotive Boilers.

PUBLISHED BY THE CLUB.
W. W. WHEATLY, SECRETARY, 168-170 MONTAGUE ST., BROOKLYN, N. Y.

New York Railroad Club.

OFFICERS FOR 1896.

PROCEEDINGS

of the Meeting held at the Rooms of the American Society of Mechanical Engineers, 12 West Thirty-first Street, New York, on Thursday Evening, Sept. 17, 1896.

Meeting called to order at 8:15 P. M. President George West in the Chair.

There were 67 members present.

On motion, the reading of the roll-call was dispensed with.

The PRESIDENT—I welcome you back, gentlemen, to our club room after three months' absence. I am not going to worry you with any speech to-night. We have with us the Hon. Jacob Kemple, of West Virginia, who has kindly offered to come here and give us a short talk, and I am pleased to present him to you.

Address of the Hon. Jacob Kemple.

Mr. Chairman and Gentlemen—I am specially pleased with an opportunity of addressing gentlemen of your profession. Having had the pleasure of traveling extensively over the United States, no one can realize

more fully than I do the fact that what we are to-day as a great enterprising business nation, having grown to wealth and prosperity, is largely due to the great gridiron of railroads which spreads itself from the Atlantic to the Pacific and from the Lakes to the Gulf. There is no business institution which has had so much to do in the last third of a century with the wiping-out of sectional lines as the railroads have. There is nothing that has done so much to wipe out Mason and Dixon's line as the railroads, which have brought both sections of our country into close business connection, interweaving all interests and combining them in such a way as to wipe out to a very large extent the political differences that existed there prior to that time. Hence, anyone who has any opportunity of travel must appreciate the power of the railroad interests in this country. Now, gentlemen, I do not believe in mincing words. I think the time has come now, in this canvass, when we should come right down to brass tacks and talk business. There is no interest which is as much jeopardized by this anarchistic, socialistic, communistic platform adopted at the Chicago Convention, and endorsed at St. Louis, as the great railroad interests of the United States. The chief plank in the platform of that party, or of those parties, discredits, dishonors and destroys to a large extent the business integrity of the railroads of the United States. Why? Because with probably one or two exceptions there is hardly a railroad in this country that is not bonded, and bonded heavily. Those bonds are largely held abroad, and you know enough to know, as I do, that the creditors of those railroads are not going to take any chances on the loss of their money which they have honestly loaned at a reasonable interest. They are expecting a return of that interest and principal in time; but if Bryan should be elected, after the 3d of November and from that until the 4th of next March every bond and the interest on every railroad bond would be enforced against every railroad corporation in the United States. They would squeeze the life out of them and make them pay those bonds as far as they could, and they would have to borrow the gold, and gold would go up to 20 or 30 per cent. premium. Shylock would demand his pound of flesh under those circumstances—and you could not blame him, because it is only human nature. Hence, I say it would jeopardize and ruin and paralyze every railroad in the United States to have such a state of things brought about as the free and unlimited coinage of silver in the United States. The very first class of people to be affected, as in all such cases, would be the employé. First his time would be reduced, and then his wages would be reduced. His corporation would have to go into liquidation, because its earning power would be to a very large extent destroyed. You will say that I am talking politics. Well, I guess I will, as you have invited me to tell my sentiments. This country for the past year has done only one-half the business it did in 1892, and just simply because business relations have been disturbed. They are bad enough now as it is, and we do not want to take any chances on making them

worse. The only way to prevent business disaster, not only to your corporation and your employés, from the president down to the man who greases the engine before it goes out of the yard—for the president himself is only an employé, and it would affect everyone who received a salary—is to vote against the men nominated at the Chicago Convention. There is only one way to preserve the integrity of my country and the honor of my nation and of my name—for I am proud to say that I belong to a family that has stood by the honor of its country, from Bunker Hill to Appomattox. Gentlemen, we cannot have this integrity destroyed by a class of people who have nothing in common with the government of the United States, nothing in common with our institutions. Now, do not misconstrue my meaning. I do not say that every man who is going to vote for Bryan is an anarchist, a socialist, or a communist. I do not say that; but I do say that there is a combined effort on the part of that class of people to destroy the business interests and the integrity of the United States, its institutions, railroads and manufacturing interests, and everything of that kind. Hence, the time has come when I believe we ought to speak out, we who are striving to make an honest living for ourselves and our families, and to uphold the honor of our country against the stain upon its name, irrespective of party lines. There is one duty to perform, to stand by the flag, the constitution, the integrity of the government of the United States. (Spirited applause.)

Do you know that the existence of this government which we now enjoy was builded largely on the honor of one man. In 1779 when the Continental Army was about to go to pieces through starvation and its raggedness and wretchedness, Robert Morris, of Philadelphia, who had given all of his own private fortune for the advancement of the interests of independence of this country, saw the situation that existed. He went to Philadelphia, called the financial interests together and said: "Brethren, I must have a million and a half of dollars for this army." "Brother Robert, what security do you offer to us for this large sum of money?" "My simple word of honor." "Robert, you shall have the money." He got the money, it was distributed among the army, provisions and clothing were purchased, the sentiment of honor kindled again, patriotism rose in the breasts of those men, they went into battle and drove the British army from the shores of America, and upon the honor of that one man the independence of the American Colonies was largely secured. (Applause.) From those days down to this, when great crises have existed, when our Government has needed money, she has been able to borrow it upon her honor or her integrity, in the belief that she would pay back, dollar for dollar, every cent she had borrowed. Hence, her credit has been as good or better than that of any nation on the face of the globe. I shall therefore vote against the proposition that American freemen, with a heritage handed down from Bunker Hill and the Revolutionary War, should say a word or do an act that would place the brand of dis-

honor or dishonesty upon each and every one of us. If we dishonor our country we dishonor ourselves as individuals, because no man will be more honorable than the government under which he lives. (Applause.)

I do not intend to go into a discussion of 16 to 1, because you gentlemen are readers and know as much about it as I do. As a matter of fact, if Bryan is elected this will be the difference in twelve months: 16 men will be walking around the streets with the seats out of their pants where one man has a job, and it won't make any difference whether he works for a railroad or any other business establishment anywhere in the country. Like a good many other Americans, in the younger years of my life I got married to a very charming little lady. By-and-by a very sweet bright little family commenced to accumulate around us, and then I said to myself: "Jacob, while you live and keep your health you are all right, you can earn a living for them; but life is uncertain; the Lord may call you most any time, and now you do not want to leave this little woman and these children with the poorhouse staring them in the face. The best thing you can do while you are well is to take out a life-insurance policy. I took out ten thousand dollars' worth on the Tontine plan. This was ten years ago. If I live ten years more I will get it all back again under the present system of finance; and if I am called away now, under the present system of finance Mrs. Kemple gets $6,000; but under the free and unlimited coinage of silver she would get about one-half that amount, or $3,000, for herself and the children to protect herself and them, and rear those children up to manhood and womanhood. And gentlemen, if it was the last word to fall from my lips, I would say, I will not do a deed, an act, that will rob my own flesh and blood out of that which I have provided for them in case I am called away, and consequently I am going to vote for an honest dollar, and all I want is to have an opportunity to earn it. The dollar of to-day is good enough for me, and always has been—the only trouble has been in the last few years, with all the hustling I could do, I could not get enough of them; and I will tell you, the people of this country are not thinking half so much of the so-called "Crime of '73" as of the possible blunders of '96 or the mistake they made in '92. Just as soon as the wheels in Mr. Bryan's head are stopped on the 3d of November, then will the wheels of industry in this country commence to go around (laughter), and we must work to that end. We heard nothing in all those years from '73 to '93, of this need of a cheap dollar—a period of twenty years, when the volume of business went up and railroads went clear across the great West. Everything was doing first-rate and nobody was complaining of the sort of money we had, and I challenge anyone to show me a period in the history of this country when there was so much general prosperity and growth and culture as there was in the twenty years that come within the period covered by what they call the "Crime of 1873."

Those were years of advancement, and all that we want is a return to

the conditions of that period. Now, gentlemen, I am getting down to plain talk. I am as lazy as the devil, and whenever it can be shown to me and proved that I can get something for nothing without stealing it or taking the chance of the penitentiary or jail, I want it and will take off my coat and vest and work for it when it can be proved to me that a 50-cent dollar will have the same purchasing power anywhere in our country or anywhere in the world that a dollar worth 100 cents will have. To-day our silver dollar goes abroad anywhere in our land or out of it, and she can hold up her head and say: "I am an American; I have a legitimate father, and he recognizes me as a legitimate child, and he holds himself responsible for my conduct. My redeemer liveth—that treasury of my country. I am proud that I am an American." That is where she stands to-day. Next year, under Mr. Bryan's plan of free and unlimited coinage of silver, she goes out over the country, across to Europe. Nobody pays any attention to her, her head is hanging down, tears are in her eyes; she is going around everywhere, but nobody will notice her. She is discarded; she is dejected. Even the Chinaman won't have anything to do with her. Directly somebody comes up and says: "Old girl, what is the matter with you?" She says: "I have lost my sponsor; I am discredited everywhere." (Laughter.) That is the American silver dollar of to-day and what it would be one year from now under the policy of the Popocratic party. Gentlemen, the government of Washington and Jefferson, Jackson and Lincoln, Grant and Blaine, shall not, must not, and cannot be handed over to the Tillmans, the Bryans, the Altgelds, the Peffers, the Llewellyns and the Pennoyers, and that class of people who represent the anarchistic, socialistic, populistic element of the United States, who do not love this republic as the men did who fought to make it and those who fought that this nation might live. This is a republican country, and we want to keep it there; it is a first-class nation, and we do not want to plunge it into the moral degradation and the business condition of Mexico, China, Japan and some of the South American republics who have tried this system and found it was an utter failure and brought dishonor and distress upon them. We want this nation to hold up its head and be proud. We want new railroads, employment for railroad men, for men of brains and genius who have given the best of their lives to this work. Railroads make towns and shops and enterprise—they do not make the railroads. Out in Iowa some years ago, where I spent some time, land was worth only $1.25 an acre. Shortly afterwards a railroad was built through there and land jumped to $15 per acre. Why? Because the employés were at work, and they were eating up the corn and beef, the pork and chickens that the farmers raised. Give us an honest dollar and an American policy and then we will return to the days of '91 and '92. The only way to do this is to put our shoulder to the wheel and go out into the highways and by-ways and enlighten the misguided people so that they will not vote for this destructive policy, will not vote for the destruction of their own bread and butter

Hence, I appeal to the name of the dearest relation that can incite any man to action—the wife, the mother, the daughter, the family, those who are dependent upon us for their support. These are the people who are appealing to us to bring back again America for Americans, a policy that will be lived up to and promoted, and under which our country will again go forth and sing:

"The star-spangle banner—oh, long may it wave
O'er the land of the free and the home of the brave!"

(Applause.)

Mr. WHEATLY—Mr. Chairman, I think there is no question which has ever been brought before the country of more importance to railroad men than the question upon which we have just heard such a striking address by the Hon. Jacob Kemple. I move you, therefore, that this meeting tender to him a vote of thanks for the very great service he has rendered to this Club and to railroad men in general.

Motion was seconded and adopted.

The PRESIDENT—The next in order is the reading of the minutes of the previous meeting.

The Secretary read the minutes of the meeting of May 21, 1896.

The PRESIDENT—If no objections, the minutes will stand approved as read. The next in order is Unfinished Business—nothing under this head.

The next in order is New Business. Has any member anything to offer under the head of New Business? If not, we will declare it closed.

The next in order is Discussion upon Technical Subjects.

The Effect of High Rates of Combustion Upon the Efficiency of Locomotive Boilers.

BY PROF. W. F. M. GOSS.

The experiments with which this paper is concerned were carried out a few months ago in the locomotive laboratory of Purdue University. They are here presented by a brief and very general description of the work, together with a discussion of some of its most significant results, and by two appendices which give the more technical descriptions, Appendix I. dealing with the apparatus and methods employed, and Appendix II. giving a summary of all observed and calculated data.

The problem to be studied by means of the experiments will be more readily appreciated if it is remembered that the boiler of any given locomotive is most efficient when worked at the lowest power practicable; that is, when the rate of combustion in its firebox is minimum. For the development of a higher power, the rate of combustion must be increased, and, as a result, the efficiency of the boiler is lowered.

The relation between the rate of combustion and the weight of water per pound of coal for the Purdue locomotive "Schenectady," while using

Brazil block coal, is shown by Fig. 1.* From this diagram it appears that when coal is burned at the rate of 50 pounds per square foot of grate per hour, 8 pounds of water are evaporated for each pound of coal; while if the rate of combustion is increased to 180 pounds per foot of grate, the evaporation falls to about 5 pounds—a loss in water evaporated per pound of coal of nearly 40 per cent. This loss may be due to a failure of the heating surfaces to absorb properly the increased volume of heat passing over

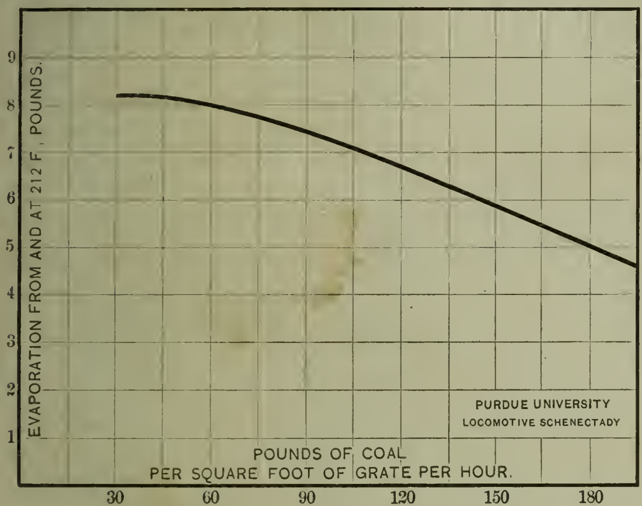

FIG. 1.

them, or to the imperfect combustion of the fuel upon the grate, or it may be due to a combination of these causes.

That a portion of the loss occurs along the heating surfaces hardly admits of question, since it is well known that any increase in the rate of combustion results in a rise in the temperature of the smokebox gases; but whether, under ordinary conditions, any considerable portion of the loss shown by Fig. 1 is due to imperfect combustion, has not been demonstrated,† and it is this question especially that the present paper attempts to treat.

The importance of the subject is emphasized by the varying practice of locomotive designers, who, in some cases, have so designed large boilers as to allow a large grate; while in others they have been content to use a grate of moderate size, upon which they have forced the combustion beyond limits which had hitherto been customary.

* Fig. 1 is reproduced from the "Railway Master Mechanic" for February, 1896, page 21.

† This question has been very ably discussed by Mr. W. H. Marshall, in an editorial which appeared in the January (1896) number of the "Railway Master Mechanic."

It will be seen that a separation of the losses which may occur at the grate from those which take place along the heating surface, could not be accomplished by boiler tests alone, because the results of such tests give the combined effect of both these losses. There are two variables involved, and in order that either may be determined one must be given a constant value. In the tests described, action along the heating surface was maintained constant, while conditions at the grate were varied.

As a preliminary step, a number of tests were outlined in which the total weight of fuel fired was to be constant throughout the series, while the rate of combustion was to be made different for each test by changing the area of the grate. It is evident that if the action at the grate were equally efficient during the several tests—that is, for different rates of combustion—this provision would cause the same volume of heat to pass over the heating surfaces of the boiler, and hence would produce the same evaporation and the same smokebox temperature. If, on the other hand, the combustion should prove less efficient for any one test than for others, a smaller volume of heat would sweep the heating surface, less water would be evaporated, and the smokebox temperature would probably be lower.

The outline provided for all observations usual in boiler testing, and, in addition to these, for a determination of the weight of fuel lost in the form of sparks, and for chemical analyses of the fuel used, of the sparks caught and of the smokebox gases. A more complete description of the apparatus used and the methods employed will be found in Appendix I.

The first test was run with the locomotive under normal conditions. The whole grate was covered with fuel, the throttle was fully open, the cut-off approximately 6 inches, and the load such as to make the speed 25 miles per hour. These conditions gave a rate of combustion of 61 pounds of coal per square foot of grate per hour.

In preparation for the second test, one-quarter of the grate was made non-effective, or "deadened" by a covering of fire-brick. The exhaust tip was reduced, so that, while the engine was running as before and using approximately the same amount of steam, the same total weight of fuel could be burned on the reduced grate as in the first test had been burned on the whole grate. Trial tests were run until it was known that the changes made would permit the desired conditions to be maintained. The rate of combustion in this test was 84 pounds per square foot of grate area.

In preparation for the third test, the grate surface was reduced to half its original area, and the rate of combustion was increased to 124 pounds per square foot of grate area; and during the fourth test only, one-quarter of the original grate was used, the combustion in this case rising to 241 pounds per square foot of grate surface.

It should be evident from what precedes, that the prescribed conditions were designed to make each test a duplicate of every other test, excepting in the matter of grate area, this being the one variable for the series.

The coal used in the several tests was of uniform quality, the chemical

analyses (Appendix II, Items 7-10) showing no greater variation than might occur in different samples from a single shipment. The maximum weight of coal fired per hour in any test was 1,087 and the minimum was 1,038, a difference of less than fifty pounds in more than a thousand, while the variation during three of the four tests does not exceed 1.2 per cent. of the weight fired. All firing was done by one man, the attendants engaged in taking the more important observations were the same for all tests, and all external conditions affecting the action of the boiler were uniform throughout the series.

Evidence of losses at the grate with increased rates of combustion, is to be found in the record of water evaporated per pound of coal, which, for the several tests, is as follows:

1. Number of test.	1	2	3	4
15. Rate of combustion ; pounds of coal per foot of grate surface	61	84	124	241
50. Equivalent evaporation from and at 212° F.; pounds of water per pound of coal	8.26	7.87	7.52	6.67
Loss of evaporation in terms of the evaporation for Test No. 1, per cent.	....	4.7	9.0	19.2

In consideration of all the conditions governing the experiments, it would seem fair to assume that the decrease of 19 per cent. in the weight of water evaporated, a result which comes from increasing the rate of combustion from 61 to 241, is a loss which occurs wholly at the grate.*

The preceding paragraph exhibits a measure of the loss which occurred at the grate of the boiler tested, when the rate of combustion was increased above 61 pounds. A large fraction of this loss is to be accounted for by the escape of sparks, and it is significant that, as the sparks increase in volume, their heating value also increases. (Items 30 and 34.)

By reducing the weight of sparks to an equivalent weight of coal, on the basis of their relative heating value, it is possible to make the following comparison:

1. Number of test.	1	2	3	4
15. Rate of combustion	61	84	124	241
14. Total pounds of coal per hour	1,c74	1,078	1,086	1,038
Total pounds of sparks per hour	61.5	95.1	128.6	176.3
Pounds of coal equivalent to spark losses per hour	46	77	111	161
Value of spark losses in per cent. of coal fired	4.3	7.2	10 2	15.5

According to popular judgment, the loss of heat by sparks has always appeared small, while the data show that, under conditions which are now common, it may represent more than 10 per cent. of the fuel value of coal

* The fact that the plan of the tests did not allow the boiler to develop the same power during all tests, may give rise to a question concerning the accuracy of this statement; it may be said that a portion of the effects produced is due to changes in power. Against such an objection, it may be urged that changes in power were comparatively slight, and it can be shown that their influence would diminish, rather than increase, the difference in the observed results. It is, therefore, safe to say that the losses at the grate are not less than these given.

fired, It is evident, however, that these losses will in general depend very much upon the quality of coal, and it should be noted that the Brazil block which was used in the tests under consideration is quite friable.

Without attempting a full discussion of the analyses of the smokebox gases (Items 37-41), attention may be directed to two important facts. These are, first, the large percentage of oxygen shown, indicating a supply of air greatly in excess of that required for combustion; and, secondly, the absence of carbon-monoxide (C O) in all excepting the last test.

All air admitted to the furnace in excess of that required for combustion is heated from the temperature of the atmosphere to that of the smokebox, and by this process heat is taken from the furnace. As the data show an increasing amount of air during the third and fourth tests of the series, it would appear that this cause must have operated to reduce the performance of the boiler, as the rate of combustion was increased.

The presence of carbon-monoxide (C O) in the smokebox gases is accepted as proof of imperfect combustion. This gas, as already noted, occurs only in Test No. 4. It has long been supposed that its formation is due to thick firing, and its failure to burn after it is formed, to deficient air supply, or to a temperature too low to ignite it. Upon this theory, its presence in Test No. 4, and its absence in the other three, are difficult to explain.

In contradiction of the old theory, however, Herr R. Ernst* has recently shown that the amount of this gas (C O) formed in the combustion of carbon depends upon the temperature of the fire; that, as the temperature of the fire is increased, a larger proportion of the carbon is converted into C O, until under very high rates of combustion, or, more specifically, when the temperature of the fire is above 1,800 degrees Fahr., the first process of combustion is the entire conversion of the carbon into this gas. He has also shown that this gas will not burn, even in the presence of air, so long as its temperature is above 1,800 degrees Fahr.; it must be cooled before it will burn. Herr Ernst argues that, for high rates of combustion, there should be a rapid transfer of the heat liberated from the combustion chamber, in order that the carbon-monoxide formed may be sufficiently reduced in temperature to burn. This theory points to the possibility of heavy losses through the formation and non-combustion of carbon-monoxide in the locomotive firebox, in which very high rates of combustion are maintained, but the results of the Purdue experiments are reassuring. It must be admitted, however, that the relation of grate surface to firebox volume, during all but the first test, gave conditions which more nearly satisfy those prescribed by Herr Ernst than would exist had the same rates of combustion been maintained on a full grate. On the other hand, it may be urged that the rate of combustion maintained in Test No. 4 was higher than any which can be found in practice, a condition which would

* "The Principles of Combustion," a paper by R. Ernst, published as an inaugural dissertation at the University of Giessen, Hamburg, 1892. (See "The Engineer," London, August 4, 1893.)

tend to neutralize the advantage of a large firebox. But, theory aside, the facts remain that the tests show very small losses by imperfect combustion, even when the rate of combustion is highest.*

CONCLUSIONS.

The results show that the most efficient furnace action accompanies the lowest rates of combustion; and while the precise relationships established by the experiments may not hold for fuel which is different from that employed, nevertheless they enforce the general conclusion that very high rates of combustion are not desirable, and, consequently, that the grate of a locomotive should be made so large that exceptionally high rates will not be necessary. They emphasize, also, the importance of spark losses, which, during the experiments under discussion, practically equaled in value all other losses occurring at the grate.

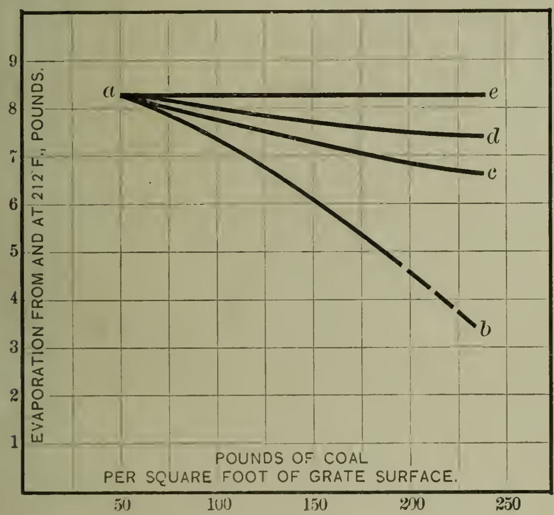

FIG. 2.

Leaving the conditions peculiar to the experiments, and assuming that the results obtained from them may be applied to the locomotive "Schenectady," when working under normal conditions, we find that the losses in evaporative efficiency which occur when the rate of combustion is increased above 50 pounds, may be accounted for approximately as follows: The relation between the rate of combustion and the water evaporated per pound of coal, under normal conditions, is represented by the line *a b*, Fig. 2. If it could be assumed that the heat developed in the furnace would

* In a list of nine analyses of locomotive smokebox gases, selected by Mr. Kent from a large number made by Mr. P. H. Dudley, three exhibit C O. The amount varies from 1 per cent. to 2.5 per cent.

be absorbed with the same degree of completeness for all rates of combustion, the evaporation would rise to the line *a c;* if, in addition to this, it could also be assumed that there were no spark losses, the evaporation would rise to the line *a d;* finally, if, in addition to these, it could be assumed that there were no losses by the excessive admission of air, or by incomplete combustion, then the evaporation would remain constant for all rates of combustion, and would be represented by the line *a e.*

That is, with the boiler under normal conditions, the area *a b c* represents the loss occasioned by deficient heating surface, the area *a c d* that occasioned by spark losses, and the area *a d e* that occasioned by excessive amounts of air and by imperfect combustion.

APPENDIX I.

APPARATUS AND METHODS.

The experiments discussed in the foregoing paper were conducted by Mr. Alfred R. Kipp,* in conjunction with Mr. Richard A. Smart, who, as Instructor in the Engineering Laboratory, had immediate charge of the work. All chemical analyses were made by Mr. Charles D. Test,† under the direction of Prof. W. E. Stone, in charge of the Purdue Chemical Department.

The apparatus employed constitutes a portion of the permanent equipment of the locomotive laboratory of Purdue University, but this experimental locomotive plant has been so many times described that it does not in this place require special description. The locomotive is of the eight-wheeled type, with 17 x 24-inch cylinders, and weighs 85,000 pounds. The boiler, with which the present work especially concerns itself, is shown in outline by Fig. 3.

The deadening, which was employed to cut out portions of the grate, was of brick laid up in fire-clay, the design being to make the covered portions of the grate as nearly air-tight as possible. The material extended across the breadth of the firebox, the sections of the grate covered being disconnected from the rocking mechanism, so that the remainder could be used with undiminished effect. Its distribution during the several tests is shown by Figs. 4, 5 and 6, respectively.

Early in the second test, ash piled up on the deadening, as indicated by the line *a b*, Fig. 4; but as the accumulation did not reach the lower tubes, it was not dislodged. At the end of the test, everything in the firebox which was not coal was credited to ash. During the third test there was less of this deposit, and during the fourth still less, an effect probably due to the presence of a stronger draft.

The thickness of fire for each test was not greater than was necessary to the easy maintenance of the steam pressure. The firing was always at regular intervals, and usually only three shovelfuls were thrown in at one time. In the fourth test the thickness of the fire equaled that of the deadening (Fig. 6).

* "The Effect of Different Grate Areas on the Efficiency of Locomotive Boilers." A Thesis by Alfred R. Kipp, B. S., '96.

† "A Study of the Combustion Products of a Locomotive." A Thesis by Charles D. Test, A. C., '96.

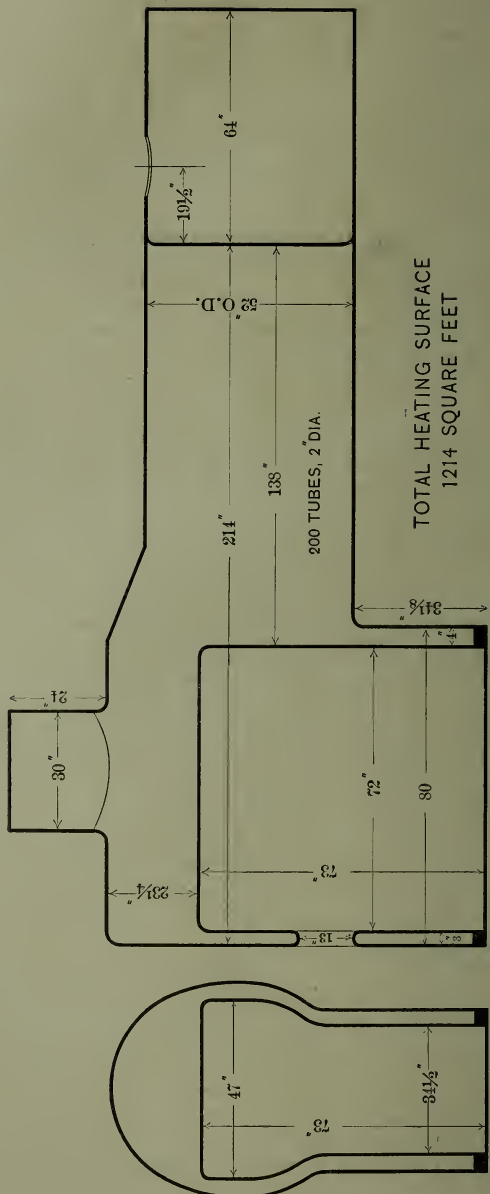
64"
19½"
52" O.D.
138"
214"
200 TUBES, 2" DIA.
TOTAL HEATING SURFACE
1214 SQUARE FEET
34⅛"
4"
21"
30"
72"
80"
73"
23¼"
13"
3"
47"
34½"
73"

FIG. 3.

The samples of smokebox gases for analyses were drawn from a point near the center of the smokebox. Ten minutes were occupied in obtaining the sample, a period sufficiently long to cover all conditions of fire.

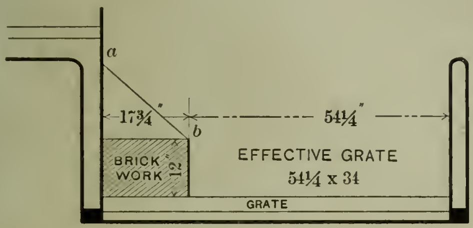

FIG. 4. TEST 2.

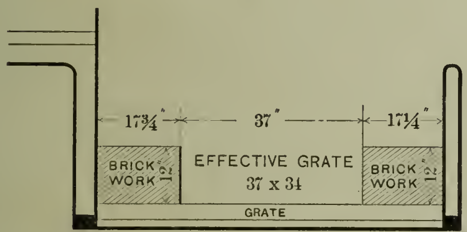

FIG. 5. TEST 3.

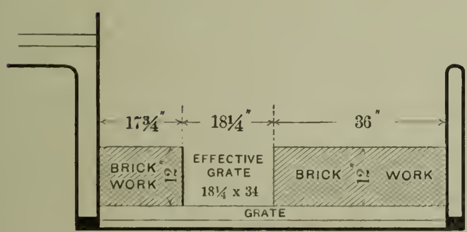

FIG. 6. TEST 4.

The smokebox temperatures were obtained by means of a Le Chatelier pyrometer, an instrument constructed on the thermo-pile and galvanometer principle, and which, for comparative work, is very reliable. The differences in temperature recorded are probably correct within less than one per cent.

The weight of sparks or cinders passing the heating surfaces is the sum of the weight of those caught in the front of the locomotive and those passing out at the top of the stack. The sparks which accumulated in the front end were easily collected and weighed. Of those which passed out of the stack, a portion only were collected, the sample being so chosen as to serve as a basis from which the value of the whole could be estimated. The apparatus employed in this latter process is shown by Fig. 7. It consists of an inverted U-tube of galvanized iron, securely fastened to a movable frame, by means of which the tip, which constitutes one extremity of the tube, can be projected across the top of the locomotive smokestack. The outer end of the tube may thus be made completely to intercept a portion of the stream issuing from the stack, and the continuous action of this stream is

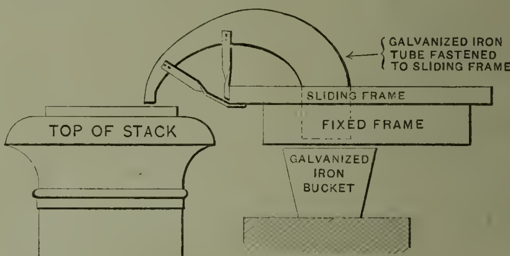

FIG. 7. SPARK TRAP.

sufficient to drive the intercepted portion through the tube and out at the other end. The gases passing the tube, bear the sparks on their current, and they are collected in a bucket set to entrap them. Reference marks upon the sliding and the fixed frames permit the tube to be placed in definite locations relative to the center of the stack. This device, when in service, catches everything excepting the lightest soot, which is allowed to escape unaccounted for.

After assuming the cross-section of the stream issuing from the stack to be cut up, by a series of concentric circles, into one circular and several annular areas, as shown by Fig. 8, the small end of the U-tube was placed in the position marked I and held there for thirty minutes, the sparks collected during this interval being credited to this position. The tube was then moved to the position II, where it remained for another period of thirty minutes. In like manner, it was made to occupy, successively, the positions III and IV, and also the positions I_1, II_1, III_1 and IV_1, the weight of sparks caught during each interval being credited to the corresponding position occupied by the small end of the tube. This end of the tube had an area of one square inch, and it was assumed that the average weight of sparks passing the tube while in the positions I and I_1 would be the same as that passing every square inch in the annular space in which these posi-

tions are located. For example, the outer annular area, in which I and I_1 are located, contains 88 square inches. If, in half an hour, 0.5 pound was collected by the tube in the position I, and in another half hour 0.3 pound was collected from the position I_1, the sum of these two weights, or 0.8 pound, collected during a period of one hour would be the average weight per square inch per hour collected from the two positions, and the weight for the whole outside annular area would be 0.8 times 88, the number of square inches, or 70.4 pounds per hour. A similar experiment and calculation gave the weight per hour delivered by each of the other annular areas II and III, and by the circular area IV. The sum of these separate determinations was assumed to be the total weight of sparks per hour delivered from the stack.

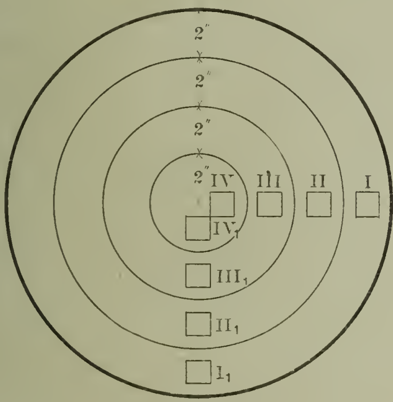

FIG. 8.

Other accessory apparatus employed was such as is commonly used in boiler testing, and therefore need not be described.

The engines of the locomotive were not involved in the tests, excepting as they served to shake the boiler, to furnish draft and to consume the steam generated. While the speed was varied slightly in different tests as a means by which desired rates of combustion might be the more readily secured, it was approximately 25 miles per hour for all tests. The running for each test, therefore, was equivalent to 150 miles.

In running the tests, regular observations were made at the beginning, and at five-minute intervals thereafter, giving seventy-three series of observations, upon the average of which the data are based. Exceptions to this rule are, however, to be made in the case of the spark record, to which reference has already been made, and in the case of the draft record, which was obtained by readings each minute during the first twenty minutes of every hour.

As a rule, all important observations were checked by independent means. For example, the feed water delivered to the injectors was gaged in calibrated tanks, and then passed through a meter, the accuracy of which was quite sufficient, had a mistake occurred in the count of the number of full tanks delivered, to permit its detection. The reading of all important pressures, also, was checked by independent recording gages. It is believed that these and other precautions taken were sufficient to insure accuracy in the observations recorded for the several tests.

Aside from their use as a means of checking other readings, the record of the Bristol recording gages was useful, also, in showing with what degree of constancy the desired conditions were maintained. (Figs. 9, 10 and 11.) On the charts of these gages, the distance between any two adjacent circles represents a definite difference of pressure; while the curved lines extending outward from the center, mark time intervals, the smallest division being equal to a five-minute interval. Figures representing the hour appear around the outside of the chart. It should be noted also that the gages are special, the time mechanism being such as will give the chart a complete revolution every six hours, which interval was by chance equal to the duration of the tests under discussion. The charts shown are from Test No. 4, for which the rate of combustion was maximum.

By reference to Fig. 9, which represents boiler pressure, it may be seen that the pen of the gage was filled at 9:18 A. M. (See chart at *A*.) The test commenced at 9:30, the record beginning at *B*, and ended at 3:30 P. M., again on the line *B*. It will be seen, also, that while the firing for this test was difficult, the pressure did not often vary five pounds from 130, which was the pressure desired.

Fig. 10 represents the chart from the recording draft-gage. This chart shows that the pen was filled at 9:15 (see chart at *A*), while the locomotive was at rest; that a minute or two later the engine was started; that the draft gradually increased during the most of the next six or eight minutes, until at 9:25 it seems to have become normal. It is known from other sources that the test began at 9:30 (line *B*). After six hours, at 3:30, the line *B* again reached the pen; at 3:31 the engine was stopped, and the draft immediately fell to less than a half an inch of water. As shown by the data obtained from frequent readings of a manometer attached to the smokebox, the normal draft for this test was equal to 5.6 inches of water.* The chart shows the maximum draft to have been 7 inches and the minimum to have been about 3 inches. In the record of this chart, the narrow points projecting inward towards the center of the circle show the drop

* The results of the test show that this draft of 5.6 inches resulted in a rate of combustion of 241 pounds per square foot of grate per hour. It would at first appear impossible that so light a draft could produce so high a rate of combustion. The explanation is to be found in the fact that the effective area of the grate was small, the volume of furnace gases moved was much below normal for such a rate of combustion, and their velocity through the tubes was consequently low. The effect of the draft was, therefore, not greatly diminished by work done in the tubes, but was concentrated upon the fire, with the effect noted.

in draft which accompanied the opening of the fire-door, and from these, the time and frequency of the firing may be determined. The broader outward projections, when abnormally high – as, for example, that which occurred a few minutes after 2 o'clock—are due to the closing of the ash-pan dampers. Variations which are less pronounced are those due to the ordinary changes in the condition of the fire.

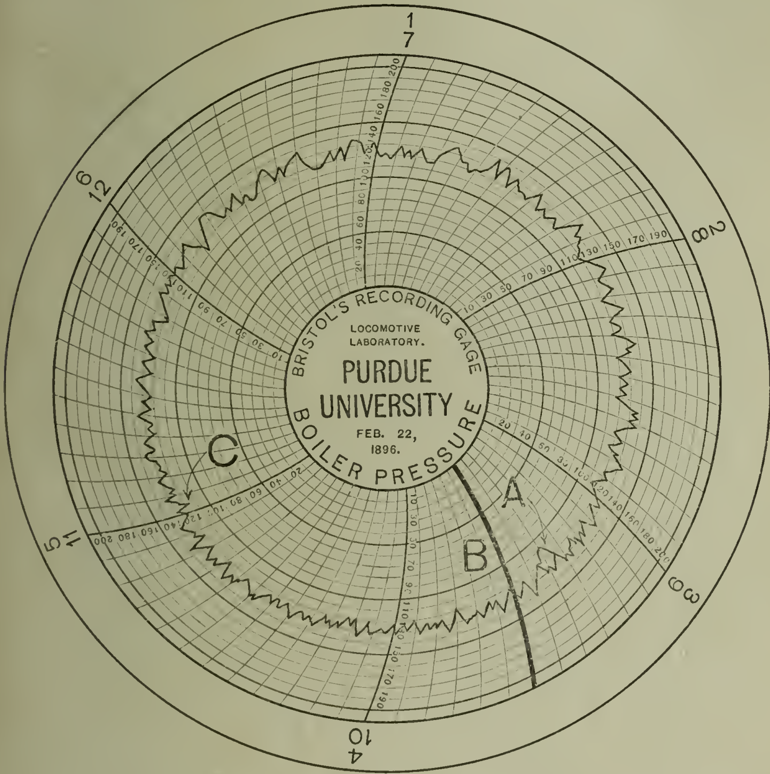

FIG. 9. BOILER PRESSURE.

Fig. 11 is the chart from the recording back-pressure gage, and gives the pressure of the steam in the exhaust port of the saddle. This, while not of direct application to the matter of the present paper, is nevertheless of interest, especially if taken in connection with Fig. 10; for example, the back-pressure chart (Fig. 11) may be accepted as giving a measure of the draft-producing force and the draft chart (Fig. 10) shows the effect of that force.

A comparison of the three gage charts given is also of interest. By reference to the back-pressure chart (*A*, Fig. 11), it appears that in starting, the engine was brought up to speed quickly, the back pressure rising abruptly from zero to that which is nearly normal for the test. The draft, on the other hand, starting from near zero (*A*, Fig. 10), did not become normal until after a run of six or eight minutes; a result probably due to

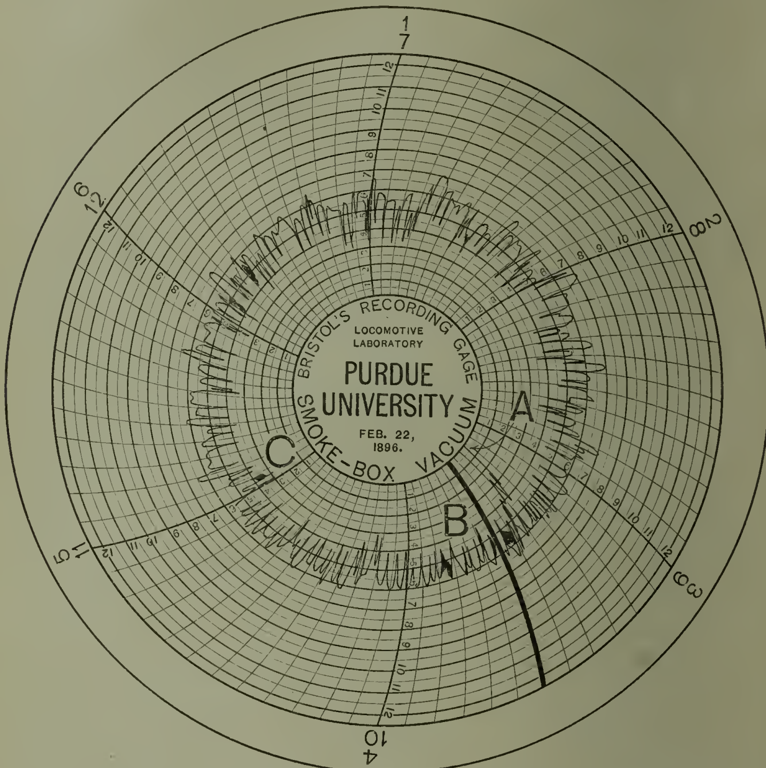

FIG. 10. SMOKE-BOX VACUUM. (In Inches of Water.)

thinness of fire at the start, which allowed at first a freer passage of air than that which afterwards existed.

Again, the boiler-pressure chart shows that a drop of pressure occurred, which became minimum at about 11:02 (*C*, Fig. 9). This, doubtless, had the effect of reducing the speed of the engine, for by the back-pressure chart (Fig. 11) it will be seen that at this time (11:02) the back pressure also was

low, and this, in turn, would naturally result in a reduced draft; a condition which is to be found faithfully recorded at *C*, Fig. 10. By the latter chart, also, it will be seen that the fireman put in five fires in about eight minutes, beginning with 11 o'clock. These served to restore the steam pressure and to send the back pressure and vacuum bounding upward.

These recording gages were not used to supply the data used for the

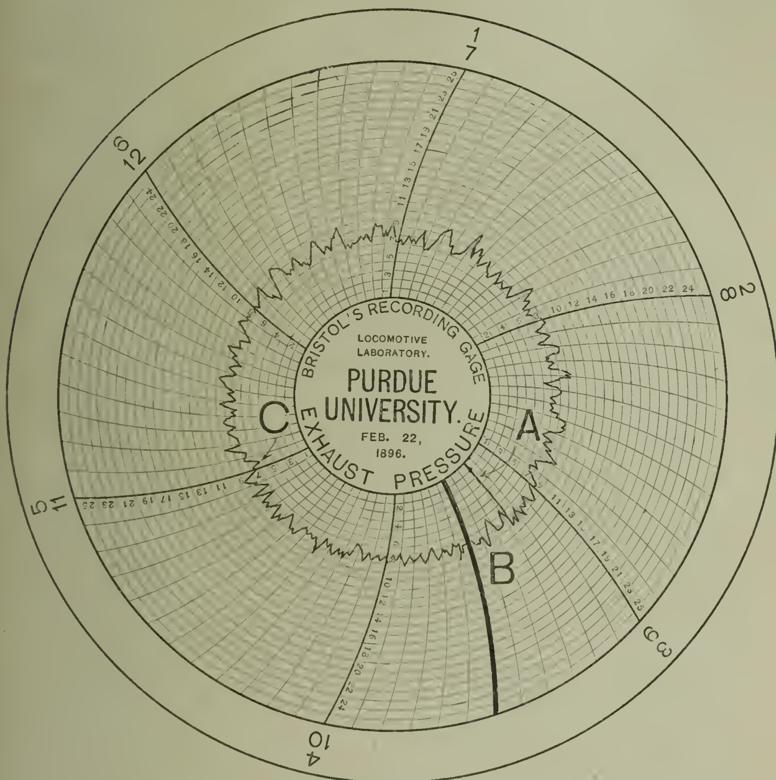

FIG. 11. EXHAUST PRESSURE.

tests, but the comparisons just noticed are sufficient to indicate the great value of self-recording apparatus, as a check against gross errors in readings taken from the more usual and more accurate instruments, and as a means of tracing the relations of cause and effect. It should be noted, also, that it is only since the advent of the laboratory that it has been possible to use such delicate instruments in locomotive work.

APPENDIX II.

OBSERVED AND CALCULATED DATA.

1. Test number....	1	2	3	4
2. Month and day (1896).........	Feb. 8.	Feb. 11.	Feb. 15.	Feb. 22.
3. Duration of test, hours......	6.	6.	6.	6.
4. Approximate portion of whole grate used.....	Full.	Three-fourths.	Half.	One-fourth.
5. Exact area of effective grate, square feet........	17.50	13.01	8.74	4.31
6. Barometric pressure, pounds..	14.41	14.43	14.34	14.47
*Analysis of Coal.**				
7. Per cent. fixed carbon.......	49.65	51.84	51.09	51.59
8. Per cent. volatile matter......	40.29	39.00	38.93	38.87
9. Per cent. combined moisture..	3.15	3.62	2.35	3.44
10. Per cent. ash.	6.91	5.54	7.63	6.10
Coal [*Brazil Block*].				
11. Pounds fired........	6522.	6628.	6716.	6328.
12. Weight of water in each pound of coal fired...	0.012	0.016	0.030	0.012
13. Pounds of dry coal for test...	6443.	6522.	6514.	6227.
14. Pounds of dry coal per hour..	1074.	1087.	1086.	1038.
15. Pounds of dry coal per hour per square foot of grate...	61.4	83.5	124.2	240.8
16. Pounds of combustible for test	5792.	5921.	5856.	5635.
17. Percentage of fixed carbon in coal, dry and free from ash.	56.	57.	57.	57.
18. Approximate number of B. T. U. per pound of combustible.	13800.	14040.	14040.	14040.
19. Approximate number of B. T. U. per pound of dry coal...	13000.	13000.	13000.	13000.
20. Theoretical evaporation from and at 212° per pound of dry coal...........	13.46	13.46	13.46	13.46
Ash.				
21. Pounds of dry ash in ash-pan for test........	446.	396.	297.	164.
22. Pounds of ash in coal fired as shown by analysis of coal .	445.	361.	497.	380.
23. Pounds of ash by analysis, minus pounds found in ash-pan	—1.	—35.	200.	216.
*Analysis of Sparks.**				
24. Per cent. of fixed carbon.....	61.74	64.88	71.32	76.44
25. Per cent. volatile matter......	4.36	4.16	3.45	3.29
26. Per cent. combined moisture..	1.82	1.82	1.66	1.86
27. Per cent. ash.............	32 08	29.14	23.57	18.41
Sparks.				
28. Pounds caught in front-end during test................	75.	213.	494.	566.
29. Pounds passing out of stack for test.......	294.	358.	278.	492.

* All chemical analyses were made under the direction of Professor W. E. Stone, by Charles D. Test, A. C.

Test Number	1	2	3	4
30. Total pounds of sparks for test.	369.	571.	772.	1058.
31. Pounds of sparks per square foot of grate per hour	3.5	7.3	14.7	41.0
32. Pounds of combustible in sparks for test	242.	395.	576.	837.
33. Percentage of fixed carbon in sparks dry and free from ash.	94.	.94	95.	96.
34. Approximate B. T. U. per pound of sparks	9870.	10360.	11200.	11880.
35. Pounds of coal equivalent in heating value to one pound of sparks	0.75	0.80	0.86	0.91
36. Pounds of coal equivalent in heating value to total weight of sparks for test	277.	457.	664.	963.
*Analysis of Smoke-Box Gases.**				
37. Per cent. carbon dioxide	5.45	6.25	4.80	1.80
38. Per cent. heavy hydro-carbons.	0.50	0.40	0.40	0.50
39. Per cent. oxygen	12.15	11.80	14.60	18.70
40. Per cent. carbon monoxide	0.00	0.00	0.00	0.55
41. Per cent. nitrogen	81.90	81.55	80.20	78.45
Other Smoke-Box Data.				
42. Diameter of double-exhaust tip, inches	3.	2.75	2.35	1.75
43. Draft in inches of water	2.2	2.5	3.3	5.6
44. Temperature of smoke-box, degrees F	647.	629.	610.	500.
Water and Steam.				
45. Pounds of water delivered to boiler	44756.	43081.	40710.	43770.
46. Temperature of feed, degrees F.	54.0	53.0	53.5	52.7
47. Boiler pressure, by gage	129.4	127.2	127.2	129.1
48. Quality of steam in dome	0.982	0.981	0.984	0.983
Evaporation.				
49. Pounds of water evaporated per pound of dry coal	6.94	6.60	6.30	5.58
50. Equivalent evaporation from and at 212° F	8.26	7.87	7.52	6.67
Horse Power.				
51. Horse power of boiler	257.	248.	226.	201.
52. Horse power per square foot of grate	15.	19.	26.	47.
Approximate Efficiency.†				
53. Ratio of heat developed in the furnace to heat absorbed by water	0.61	0.59	0.56	0.50

* All chemical analyses were made under the direction of Professor W. E. Stone, by Charles D. Test, A. C.

† The efficiency is approximate only, since the heating value of the coal is only approximately known. But as the same coal was used for all tests, there can be no error in using this factor for purposes of comparison within the limits of the present series of tests.

The PRESIDENT—Mr. Forney, won't you open the discussion?

Mr. FORNEY—I thought, perhaps, I would receive an invitation to make a speech on Free Silver, as we have heard so much to-night on the other side. I don't think it is fair to discuss a political question without giving both sides an opportunity to be heard. In this case there are three sides—one is the Bryan, one the Palmer, and the other the McKinley side, and for that reason I expected to be asked to speak on one side—I don't care which—in order to have the subject discussed. (Laughter.)

The PRESIDENT—I have no doubt, Mr. Forney, that the members would be very glad to have you take the floor for the silver side.

Mr. DONNELLY—I move you, Mr. President, that we postpone the discussion of the subject proposed, and hear from Mr. Forney to-night on the silver question.

Mr. FORNEY—I am very much obliged. If I had the time I would say something handsome; but, unfortunately, I cannot. If, however, you will prepare something on Free Silver, I will be very glad to prepare something, too. (Laughter.) The paper which has been presented here by Professor Goss is an admirably good one. It relates to a subject in which I have been interested for years past. Professor Goss has shown in that paper very conclusively that as the rate of combustion increases per square foot of grate area, the amount of water evaporated per pound of coal decreases. Now, I do not think that that has ever been proved as clearly as it has been in this paper. It is a matter of very great importance to the railroads of this country, which leads me to the suggestion that it would be a very wise thing if the railroads would employ ability such as that of Professor Goss to investigate in the manner he has. I happened the other evening to cut from one of our New York newspapers an article which was called out by a letter written to the London "Times," in relation to the competition of German with English manufacturers, in which it was explained why it is that the Germans are getting ahead of the English in a great many cases, and the writer gave this as a reason:

"Each large works has the greater part of its scientific staff—and there are often more than one hundred Ph.D.'s in a single manufactory—occupied, not in the management of the manufacture, but in making inventions. The research laboratory in such a works is only different from one in a university by its being more splendidly and sumptuously fitted than the latter. I have heard from the business manager of such works that they have, not infrequently, men who have worked for four years without practical success; but if they know them to possess ability, they keep them, nothwithstanding, and in most cases with ultimate success, sufficient to pay the expenses of the former resultless years."

The editor of the paper then says: "Is it any wonder that, by such methods, Germany has come to control the fine chemical markets of the world? By her superiority in this respect alone she is able, silently and without any legislation, to lay a tax upon almost every industry in every

country. German manufacturers have come to a clear understanding of the commercial importance of science. Not long ago one of them offered a university professor a very large salary simply to come into his works and make experiments regarding the practical use of certain scientific methods which the professor had been developing. This close relationship between science and industry is good for both. It puts the best-trained and highest inventive power at the service of manufacturers, and it also furnishes the scientist not only with new openings for a livelihood, but with wide opportunities of research. Professor Ostwald declares that some great establishments provide finer technical means and appliances to chemists than any university laboratory."

Now that letter and that article indicate what the results are of employing scientific ability in private manufacturing establishments, and the point I wish to make is, that if the railroad companies would devote the money spent in some other ways, to scientific research, they would probably not be so poor as they are now. One of the subjects they could spend it on to advantage is the question of combustion of fuel. The fuel account is a great item and runs up into the millions on some roads; but notwithstanding that fact, we are going on as we have been going on for the past twenty or thirty years, without any material difference in the way of burning fuel.

Professor Goss, in carrying on his experiments, in one case burned 61 pounds of coal per square foot of grate area per hour, in another 84, in a third 124, and in the fourth 241. Now, the evaporation in pounds of water per pound of coal varied in these tests, respectively, 8.26, 7.87, 7.52, 6.67, showing that the evaporation diminished as the rate of combustion increased. That is all very clear and plain. There is one point, however, that it would not be out of the way to mention here: An ordinary passenger engine would burn about 50 pounds of coal per mile on a grate of, say, 25 square feet of surface. The rate of combustion is almost 61 pounds; that is the average rate over the whole run of, say, 100 miles, while the maximum is very much higher and the minimum very much lower; and the question is whether the economy would increase with a lower rate of combustion. During a large part of the work it is burning less than 61 pounds per square foot of grate area, and very probably, if it goes down to a very low point, the economy would be less. If you have a Wootten boiler with a very large grate, it might be very much lower than 10 pounds per square foot. So that I think, in that respect, Professor Goss' experiments are not quite conclusive.

From the investigations which he has made, it seems to me probable that what would result in the greatest economy would be a larger firebox and a larger grate area than we have at present. Now, as you know, some recent locomotives built in this country have all their driving axles in front of the firebox. With engines of that kind it is possible to widen out the firebox as wide as you want. Mr. Rhodes, of the Quincy road, has ex-

perimented for the last few years with an engine of that class, and he told me he was getting 15 per cent. economy out of it, compared with others running alongside of it. Now, if that is accomplished by simply getting a wider and deeper firebox, 15 per cent. economy achieved, it is certainly important for the railroads to know it. Some years ago Frederick Siemens read a paper calling attention to the fact that as soon as the flame came in contact with any solid substance combustion was immediately arrested. You can prove this by putting a wire or a rod into an ordinary gas flame—it will immediately begin to smoke—and his conclusion was that in all furnaces the aim should be to keep the flame away from the sides and top of the firebox until the process of combustion was entirely completed. By having that firebox which Mr. Rhodes has, which is very nearly a cube, it is very much easier to keep the flame away from the top and sides of the firebox. It therefore seems desirable that we should have a firebox not only of that form, but with the sides of the grate covered with dead plates, and in that way keep the flame away from the sides before it enters the flues; and I believe it is due to that, as much as to anything else, that Mr. Rhodes has achieved the economy referred to. Of course, a large grate has a great deal to do with it; but the protection which the flame has in a large firebox is an important element.

In reading on this subject some time ago, I found an article published in a German paper, in which it called attention to the fact that by injecting a small stream of water into the firebox it would make a more intense combustion than could be obtained without it. The writer had experimented with that method and proved that he could promote combustion in that way. It seems odd to say that by squirting water into a flame you can make it burn more freely. Some time ago in talking with Dr. Dudley, of Altoona, who is an authority on such matters, he said that it was found by some Frenchman that when carbon was entirely free from moisture that it did not readily combine with oxygen. Under those conditions it was, in fact, almost impossible to have them combine, and a certain amount of moisture seemed to be necessary to promote combustion. That is a sort of collateral proof of the correctness of my German friend's experiments.

Another curious fact, and which Professor Goss refers to, is that at very high temperatures a very large amount of carbon monoxide $C\ O$ is formed, and it does not then readily combine to form carbon dioxide $C\ O^2$. In the latter combination very much more heat is developed than when carbon monoxide is formed. This waste approximately occurs at the higher temperatures, and it seems probable that the jet of water has the effect of supplying moisture and cooling down the fire, and thus promoting the combustion of the fuel.

There seems to be a sufficient promise of success in the direction indicated to warrant some of our railroad companies to have thorough series of tests made. The ground which should be covered would be to test, first,

large fireboxes, nearly cubical; next, try the water jet and see what there is in that; third, grates and dead plates of different proportions. My own impression is, that if such a series of tests were carefully made by a thoroughly practical person with a level head and having some knowledge of science, important results would be obtained. Our present methods of burning coal are not economical; they are wasteful.

Mr. HILL ("Locomotive Engineering")—I want to say a word about what Mr. Forney was speaking of in regard to using a jet in the fire. I made something of an experiment of that kind myself. I ran an engine some years ago with this arrangement and found the jets very detrimental. I tried it from the crown sheets, the flues and everything else, and it did not work. (Laughter.)

Prof. GEO. S. STRONG—I want to confirm Mr. Forney's opinion in regard to the character of this paper. I am very glad to see such experiments made by a man of Professor Goss' standing, and I think that this kind of investigation will do more to convince railroad people of the necessity of having boilers of sufficient capacity to do their work than any other class of investigation. This is a subject to which I have given a great deal of time and study and experiment, not only on locomotives, but on stationary work, so that I can speak from both standpoints. Now, if we were called upon to design a stationary boiler to give the highest results, we are never willing to go beyond 20 pounds to the square foot of grate area as the highest rate of combustion the boilers are to be called upon to do; 16 pounds is considered better. When we get down to 12 pounds we think we are going the other way; we are going too low. At 12 pounds we do not get good combustion. If we get above 20 pounds we get to the wasting point, when the fuel leaves the fire and goes out into the air in finely powdered, unconsumed carbon. A number of years ago I was about to build a locomotive for the Lehigh Valley Railroad, of a radical type, and I desired to find out the most economical grate area to have on that engine. We had an engine with a Wootten boiler with 84 square feet of grate area. Mr. Mitchell, well known as an experimenter and a man of great ability in that line, was running that engine on the heavy grade between Wilkesbarre and Summit. To see what was the most economical amount of grate area we made a series of experiments. We commenced by bricking-in the firebox on both sides, closing in towards the center. We found the grate was too big; we could not keep the fire alive at the sides; it would die out for about 12 inches on each side. Then we got better results, and we burned buckwheat and pea coal. After experimenting in that way we took out the brick from the sides and built a dividing wall nearly to the end, leaving about 2 feet at the front of the firebox. We built that wall up to the crown sheet. That gave us better results, and we cut the grate area down to about 50 square feet and got better results than with 84 feet, and afterwards we built the new engines on that idea with two fireboxes with a combustion chamber, and one of

those engines has been running fourteen years and is still doing good work. We have on that engine gotten as high as 1,810 indicated horsepower out of the 1,848 feet of heating surface and 60 square feet of grate area—that is, with soft coal, pulling fast trains 60 miles an hour, 320 turns a minute. Now, I have noticed on the test made by Professor Denton and Mr. Deane, on the Old Colony road, between Boston and Providence, where they ran from about 84 pounds down to 54, they got a saving of something like 20 per cent., due to the reduced rate of combustion when they got down to 54. On the Lehigh Valley we made a number of tests with engines having 60 square feet against engines having 35 square feet, and in that case we got about 33 per cent. saving, due to increased grate area and better combustion. I have not any doubt that it will be found that when we can get down below 50 pounds, even as low as thirty pounds, in locomotive practice, we will get good results. The simple fact is that that a very large part of the coal is carried through the smokestack in an unconsumed state, in the form of coke which is not consumed, but carried through and out into the air, and this is evidence that a very large amount of fuel is wasted. The question is: How is it possible to get down as low as 30 pounds? Mr. Forney wrote some years ago what was not intended as a serious editorial article, but which he confirms to-night, and that is—How can we reduce the quantity of coal necessary to drive a locomotive? There are a number of ways that are not being utilized to-day. One of the greatest losses you contend with on locomotives is that you feed your locomotive with cold water. If you go to any manufacturer running a large plant and make the proposition to him to fit up his boiler with an injector, he would want to know whether you were insane or a fool. Several years ago I went over to the Midvale Steel Works at Philadelphia. I saw Mr. Davenport, and he said to me: "Go in and see Mr. Sellers." I saw Mr. Sellers and showed him my heater. He said: "It is the only one that I have seen that is good for anything, and we have not got one in our establishment." He rang a bell and called Mr. Bancroft, and said: "Mr. Bancroft, you arrange with Mr. Strong to put in a heater." Mr. Sellers said to me: "Would you fit that heater with an injector or a pump?" I said: "Mr. Sellers, that is a very funny question for you to ask me; but if you want to get the greatest economy, do not use an injector." He ordered a pump. We put that pump on, and for a year I could not find out what saving they were getting; the engineer would not tell me—no one would tell me. At last they put in a new boiler, and sent for an expert from New York to go over and test it. Mr. Richard Buel was the man who went over and made the test. He did not get the results, with the injector feeding through the heater, that he wanted; then they put the pump on the engine, and they got a saving of 22 per cent. He made that test three different times and it came out the same every time. Mr. Bancroft was over a few weeks afterwards and he said: "How much do you claim for your heater?" I said: "About 12 per cent."

"Well," he said, "how do you account for that?" Then he told me all about that test. I said: "I account for it on the theory that your injector wasted about one-half and the heater saved the other half."

Now, there is one saving; and yet you will laugh at the man who wants to put a heater on a locomotive boiler. Talking about things I have experimented with, I put a heater on a Chicago & Alton engine and got the same saving—22 per cent. There was only one trouble with that arrangement—we did not then have any flexible iron connection to force the water through. There is not now any reason why the tender should not be built with a heater under it as a part of it, and force the water with a pump, either located, as we had it, on top of the tender, or as a pump driven from the axle, which would be more economical. That is one source of saving. We know that compounding is another saving; we know that when we come to put a compound cylinder on a boiler, the boiler does not have so much to do. When we come to take these things and put them together, we find that it is possible to improve the boiler and make it do double what it does to-day—and we have got to limit it to what we can carry on the rails and bridges.

Mr. RUFUS HILL (Pennsylvania Railroad)—I would like to call Mr. Forney's attention to a series of experiments made some years ago, in which he was interested in a scientific, and I in a practical way. At that time the Wootten boiler was impressed upon me very strongly for the burning of pea coal. We equipped an engine which was 17 x 24 inches, with a Wootten boiler, and the hard-coal feature of it did not suit our service. At that time we were burning semi-bituminous coal, so I came to the conclusion that we would make a soft-coal engine of it, and Mr. Forney found it out, and came over and offered some suggestions, and we did make a series of experiments in line with this paper and it agreed with what the professor has proved in his experiments. We wanted to ascertain the maximum and minimum grate surface necessary. The engine was used on passenger excursions trains, having a maximum of 24 to 25 passenger coaches loaded with people, making 30 miles an hour. The grate area of 64 square feet would not do very well, as we had too much grate surface. So I commenced to reduce it by bricking off 3 x 8, 24 feet of grate surface. With the reduced grate surface we made the engine an eminently successful soft-coal burner. Then I went to work and built a brick wall right in the middle of the furnace, making practically two furnaces, and we not only got an economical soft-coal burner, but we burned up the smoke as well. We fired alternately on one side and then on the other. The combustion chamber was a good feature, and gave us a chance to burn all the smoke and gas, and we did not pass any sparks through the smokestack. Mr. Forney was interested in that experiment at that time in a scientific way, as I said, and I in a practical way, and we found we could get too much grate surface as well as not enough.

Mr. WEST (New York, Ontario & Western Railway)—I notice in this

paper that wherever the grate area is reduced the exhaust nozzles are also reduced. I do not quite understand why they did that—why they did not make some experiments with the same grate area and vary the size of the nozzles, or leave the nozzles as large for all the tests. Take the sizes of the exhaust nozzles of the several tests—3 inches for the first, 2.75 for the 2d, 2.35 for the 3d, and 1.75 for the 4th; and then take the total of the sparks thrown out in each case in the order named—369 pounds, 571, 772 and 1,058; and then the pounds of coal equivalent in heating value to total weight of sparks—277, 457, 664, 963. Now, it seems to me that is not a fair comparison. We do not know but what if they had reduced the grate area with a larger exhaust nozzle, it would have made a great deal better showing.

Mr. FORNEY—The object was to burn the same amount of coal on the grates of different sizes and find out what the result was.

Mr. WEST—About six months ago we made an experiment on our road with an engine with a firebox 34 x 72 inches, and another engine with a firebox 34 x 108 inches, hauling the same train, and we saved about 1 cent a mile with the larger firebox, doing the same work, hauling the same train, showing that the larger boilre was the most economical for the work.

Mr. BALL—In order to get combustion in a locomotive boiler with natural or artificial draft, I think that the burning of the fuel is to a great extent dependent upon the apparatus you use to produce the draft. You know that in order to burn a quantity of fuel we must have an artificial draft with a locomotive, and a great many devices have been patented. The principal thing is to produce the greatest amount of vacuum in the smokebox, and the next thing, outside the arrangement of grates, is to arrange for the proper distribution of the flues so as to utilize all the flues in the boiler. In my experience there are very few boilers that do that, either burning too much through the top flues, too much through the center or too much through the side flues. The principal thing is to make each flue do its share of the work. Then there are a certain number, you know, that will get blocked up, so that we are seldom utilizing over five-sixths of their surface, especially of the bottom flues. I am connected with an exhaust nozzle to-day by which we are striving to get equal draft through all the flues, and if this is done it will, of course, increase the efficiency of the boiler. The great trouble with the Wootten boiler is the difficulty of burning the fire on the sides, and not burning it directly in the center. The fire will die out on the sides, and you get the same results with the Wootten firebox to-day, under that condition, as by bricking it up. I have found, in experimenting with the burning of pea coal, that it is the best thing to keep the fire heavy on the sides, and if it dies out you get the same results as by bricking it up. I would like to ask Mr. Strong where he gets the heat from for heating the water without going short on the draft.

Professor STRONG—It only takes about 15 per cent. of the total amount of steam to heat the water up to 212 degrees.

Mr. WEST (New York, Ontario & Western Railway)—I met a gentleman yesterday, an advocate of the compound engine, and he inquired whether our road was using any compound engines. I told him we were not. He asked me whether I was in favor of the compound engine, and I told him "No." He said: "Well, one thing you will have to admit, and that is, that the compound fellows have made the simple-engine fellows hustle." Well, it has served that purpose. They have got to work to show economy in fuel, and I think the advocates of the simple engine have worked wonders in that direction. We have been careless in the use of fuel. The question of fuel has not been taken into consideration; we have used it about as we would ballast or dirt, and when our general managers have shown us the economy claimed for the compound engine, we simple-engine fellows have tried to see if we could not get somewhere near the mark.

Mr. SAGUE (Schenectady Locomotive Works)—Any locomotive man must realize the great value of tests of this kind, as all locomotive designers must frequently feel the lack of experimental data upon which to base their designs. If the problem is brought before us as to how much of an engine we can supply for a certain specified weight on the track, the question at once arises—How much of that weight should be put into the tube heating surface, and how much into the size of firebox? and data on the subject is lacking, and the results of experiments vary greatly. In this connection there are some points in the paper that I would like to comment upon:

Referring to the diagram on page 11, Professor Goss says that the area *a b c* represents the loss occasioned by deficient heating surface. As I take it, the curve *a b* is the result given by previous tests of this engine, in which the grate surface was maintained constant, and in which the rate of combustion and total amount of coal burned were increased by increasing the draft. The loss shown by these tests is very much greater than when the total amounts of coal burned on the grate were constant, as in the tests detailed in the paper. The area *a b c*, which represents the loss due to deficient heating surface, can be compared with the area *a c e*, which represents the losses due to increased rates of combustion; and we can therefore, I think, form the conclusion that the loss due to deficient heating surface is greater than that due to deficient grate surface in the ratio of the area *a b c* to *a c e*.

It will also be noted that an important part of the loss found in these tests is due to the amount of sparks which were drawn through the tubes. In the test burning 61 pounds of coal per square foot of grate, this loss was 4.3 per cent.; and at 124 pounds about 10 per cent. Professor Goss speaks of the coal being very friable, and consequently the engine probably emitted a great many more sparks than it would have done with some other grades of coal.

I would also say that the rate of combustion in Test No. 4, 241 pounds,

is much greater than anything that is used in locomotive practice, except in a very few special cases of hard service with engines having the deep firebox between the axles and frames; and if we want to get at the loss which occurs in average locomotive service, we would refer to Test No. 3, which shows about 124 pounds of coal per square foot of grate per hour. Using this figure for some large passenger engines which we have recently built, having about 30 square feet of grate area, would give 3,700 pounds of coal burned per hour, or nearly 2 tons—a large amount to burn in any locomotive. Mr. Forney has mentioned that locomotives, as ordinarily run, do not show very high rates of combustion; and though they may be reached under certain conditions of service, they do not represent average practice. If the rate of combustion is calculated from the number of miles run per ton of coal, the average figure will be comparatively low; and I therefore think that, instead of assuming that the loss which takes place in locomotives is that which would be indicated by Test No. 4, it would be fair to say that the loss is nearer that shown by Test No. 3. Mr Marshall is present, and I would like to hear some discussion from him on this subject.

Mr. MARSHALL ("American Engineer, Car Builder and Railroad Journal")—I think that the one point on which Professor Goss has been striving to throw light has not been brought out in this discussion as fully as it might have been. We have a good many tests in service which show conclusively that the evaporative efficiency of boilers falls off as they are forced, but I think this test stands alone in its attempt to show to what that loss of efficiency is due. If we know that a boiler is forced in a certain service, and that the performance has fallen off, that does not by itself indicate to us what we should do—make a change in the grate, or furnish a larger heating surface, or both. In looking over the figures as presented here, the point that astonished me most is the loss by sparks. I did not suppose it was as great; and as Professor Goss says that his coal is particularly friable, it may be that the loss is not so great in the ordinary service; but that is something we do not know until more tests are made. I think this series of tests is of value, not only in itself, but because it suggests lines on which other tests should be made.

If you will turn to page 9 you will find two tabulated statements there, and in the last row of figures in the lower table you will find there the value of the spark loss; it rises from 4.3 to 7.2 per cent., to 10.2 per cent., to 15.5 per cent. in the several successive tests. Now, if we take the first test as the standard of performance we find what the excess losses are as the combustion is increased, we get it by subtracting 4.3 from the others, which gives us for Test No. 2, 2.9 per cent., for No. 3, 5.9 per cent., and for No. 4, 11.2 per cent—which are the extra losses from sparks accompanying the increased rate of combustion.

The lower line in the upper table gives the total loss of evaporation in terms of the evaporation for Test No. 1: and if in Test No. 4, for in-

stance, we subtract from the 19.2 loss of evaporation the 11.2 loss from sparks, we have left only 5 per cent. due to imperfect combustion, imperfect absorption of the heat by the heating surface, and the additional amount of heat carried through the smokestack. This 8 per cent is lower than most of us would have thought, when the rate of combustion rises from about 60 to 240 pounds of coal per foot of grate per hour.

On page 23, in Appendix II, there is an analysis given of the smokebox gases. The figures show that the amount of free oxygen here is very large, indeed, and that would seem to point to the fact that a very large amount of air has been used—more than we would consider necessary to burn the coal in regular service; and that is particularly true of the last test, where 240 pounds per square foot were burned, where we have 1.8 per cent. carbon dioxide and 18.7 per cent. of free oxygen. Throughout all the tests there are more or less hydro-carbons in the gases, showing that they have been driven off without being consumed; but it is only in the last test that we have any carbon monoxide That analysis would indicate that there was a greater loss than 8 per cent. due to imperfect combustion. It appears to me that, possibly, the presence of carbon monoxide in the last test might be partly attributable to the position of the grate for that test. If you turn to Figs. 4 to 6 you will see that as the grate was blocked the first time, the average distance from the fire to the tubes was greater than in the full grate; in the second case it was the same; in the third case the grate is on the average nearer the tubes than in any of the other tests. Now, with the large amount of air passing through the fuel, the speed of the gases would be very great in passing to the tubes; and even though the passage through the tubes would be as slow as in the other tests, the action in the firebox would be more rapid, and there would be very much less time for a perfect combustion. I think that if that opening had been placed in the third quarter instead of the second from the tubes, it might have improved the result.

The whole paper is very suggestive as to what might be done, and I do not think we need confine ourselves to laboratory work in order to accomplish it all, although laboratory work is desirable and Professor Goss' paper is excellent; but in England some tests were recently made of a locomotive boiler jacked up in the shop, and one on the road. Unfortunately, it was a switching engine and not very large, and the rate of combustion was small, and, furthermore, the coal used was very good, so that it would not apply to American practice; but I would say that the laboratory and road tests agreed closely in the rate of combustion per square foot of grate surface per hour, the evaporation under those two conditions was almost the same, and an analysis of the smokebox gases showed them to vary very little; and the whole comparison shows that a test can be made on the road and check off very closely with one made in the laboratory—but, of course, a great deal can be done in the laboratory that cannot be done on the road.

Mr. FOWLER—I think that Professor Goss infers in his paper that

part of the losses are due to inefficiency of the heating surface, and I should conclude, from his paper, that the remedy would be greater heating surface when the combustion is increased. Of course, in this there are mechanical difficulties, and we have about reached the limits; so that the losses that are due to increased combustion when the engine is forced —and we are compelled to force it, to haul the trains put behind it—it would seem almost a hopeless task to avoid, or to do anything better. The length of time the gases are in the tubes is so short that, if they enter 200 or 300 degrees higher than they do now, why, of course, the amount of heat absorbed must be less where the combustion is higher, although the temperature is higher than it would be with a lower rate of combustion; so that I do not see how that can be remedied. So far as the loss from cinders is concerned, I think that we are all surprised that is so great. I was recently standing by an engine which was being sparked after a run of only 30 miles, and the front end was just full, and the sparks were in elegant condition—just as nice coke as you ever saw. I remember a case some years ago where one of the Wootten engines ran over the road, with Mr. Wootten on, and it got out of coal. Mr. Wootten proposed to load it up with cinders, and they did so, and had no trouble in making steam. So, of course, that loss is very heavy; but still, I think all of us are surprised that it is so great.

Mr. STRONG—About the coal being burned in regular practice—I was talking with the mechanical engineer of one of the Western roads, and he tells me that they are burning, regularly, 225 pounds of fuel to the square foot of grate per hour. Now, one of the most remarkable and convincing illustrations I have ever witnessed of the two systems of burning coal on locomotives occurred a number of years ago. I had a locomotive out on the Chicago & Northwestern, and we were sent up to Baraboo—which is on a division well up towards the center of the State of Wisconsin—where there was a steep hill—the only steep hill on the road—and the object of sending us up there was to have the superintendent conduct a lot of pulling tests against another engine similar to it as to the number and diameter of drivers. The yard was only a short distance from the foot of this hill, and the test consisted in loading each engine, and keeping on loading each engine until it stalled on the hill. The engine took a load, and if it went over the hill it came back and got more cars until it stalled. The engine I had had 60 square feet of grate area, and the other one had 21 square feet. Our engine was fired in the yard, and we could go over the top of the hill without putting another shovelful of coal in it; and the fire was burning low, with the lever away down in the corner and the engine pulling all she could. With the other engine, as soon as the engineer pulled the throttle the fireman commenced shoveling coal, and you could watch the fire inside the firebox. It did not rest on the grate at all; it was simply a boiling, seething mass, and it did not stop there—a big portion of it went out through the stack.

Mr. FOWLER—There is one question I would like to refer to, brought out by Mr. Forney's remarks regarding injecting steam into the firebox when burning coal. A few years ago, in Michigan, we had some coal that was simply atrocious—the worst in the world—and we made some attempts to burn it, and found that with a natural draft we could not do anything with it at all. But we put a steam blower in a closed ashpan, and we succeeded in getting very good results with that very bad coal. The coal is so bad that they do not take it out of the county; but we burned it with a steam blower and a closed ashpan.

Mr. WEST—I was master mechanic on the middle division of the New York, Pennsylvania & Ohio when the experiment was made. We ran four ½ or ⅜ inch pipes through the lower row of tubes, and they took steam from the bottom and ran into the firebox, and they were pounded out flat at the ends; and so long as we kept those ends flat we could consume the smoke, and also make a nice saving in fuel; but it was almost impossible to keep those ends flattened down sharp.

Mr. FOWLER—I saw that same thing on the Chesapeake & Ohio road, between Sharpsville and Washington, on their "Fast-flying Virginian." The engineer came over the road with me, and he is delighted with it, and certainly the engine does not show any smoke. I asked him regarding the nozzles he was using, and he said they were having no trouble with them in burning out. I think they are applying that steam just below the firebrick arch. The engine was steaming very heavily when I was on it, and I could not see just what it was.

Mr. BALL—Mr. President, I notice here, on page 23, that the temperature of the smokebox in the fourth test was only 500 degrees—on the first it was 647; second, 629, and third, 610—and they were using 1.75-inch exhaust tips. The very small grate area that appears in that test, and so near to the tube sheet, too, proves conclusively that the amount of air passing through reduced the temperature of the gases in the smokebox. It will be seen, where we have a bad spot in the front end, the temperature falls very quickly; and I think that the temperature falling in this case is due to that—due to the intense draft and the small grate area—and then we see in the other case about 20 per cent. of the coal passed through the flues in sparks.

Mr. FORNEY—I rise to move a vote of thanks to Professor Goss for his admirable paper. There is one class of people we should remember before we give up this discussion. I think perhaps as much depends upon the fireman as upon anything else, and the question comes up how to improve the breed and education of firemen. It seems to me that it might be very proper—and, in fact, it might be possible—to improve the breed of firemen; but I do not know just how it could be done. Down in Maryland, some years ago, the good terrapin became very scarce, and they set to work to confine them and breed them artificially; but it was soon found that the terrapin were not so good as in their wild state. Now, very

likely, if we attempt to cage the fireman he will not be so good as the wild ones. I think nothing gives freedom like good pay, and I think if we increase the freedom of the fireman by giving him better pay it will improve him.

Mr. Forney's motion, tendering a vote of thanks to Professor Goss for his paper, was adopted by a unanimous vote.

Mr. HIGGINS (Lehigh Valley Railway)—In the first place, I want to commend the arrangement of having papers, similar to the one prepared by Professor Goss, sent out to the members of the Club, before the meeting, in sufficient time so that the different members can become familiar with the contents of the paper and be better prepared to discuss same. I hope this marks a permanent change in the manner of conducting the business of the Club, as it certainly is not possible for a member to intelligently discuss a paper on a technical subject without some preparation.

The paper presented by Professor Goss is of value in a general way, in that it shows the saving that may be effected by having the grate surfaces of locomotive boilers made sufficiently large to reduce the consumption of fuel per square foot of grate per hour to an economical point; but at the same time, I think there is such a thing as having too large a grate surface, and I think steps should be taken to ascertain the maximum limit of grate surface with anthracite and bituminous coal, in connection with the cylinder volume and the class of work that the locomotive is designed for.

I hardly think that the fourth paragraph of the paper agrees with the seventh paragraph. The former reads as follows: "Since it is well known that any increase in the rate of combustion results in a rise in the temperature of the smokebox gases . . . . ." The latter reads: "If, on the other hand, the combustion should prove less efficient for any one test than for the others, a smaller volume of heat would sweep the heating surfaces, less water would be evaporated, and the smokebox temperature would probably be lower." On page 23 the temperature of the smokebox was higher in Test No. 1, with a low rate of combustion, than it was in Tests Nos. 2, 3 and 4, with the higher rates of combustion.

I also think too much stress has been placed upon the importance of spark losses, as noted under the head of "Conclusions," on page 11. While Test No. 1 was being made, when the engine was working under normal conditions as to area of grate, and particularly as to diameter of exhaust tips, the loss due to sparks, reduced to pounds of coal, equaled 277 pounds, or a little more than 4 per cent. of the total amount of coal consumed during the test. It was only during Tests Nos. 2, 3 and 4 that the loss due to the sparks was in any way noticeable or excessive; and Tests Nos. 3 and 4 certainly do not represent actual service conditions, as we would hardly expect to have an engine, burning bituminous coal, give satisfactory results, using double exhaust tips, diameter of each tip being 2.35 or 1.75 inches.

I wish to confirm the figures presented by Professor Goss as to the efficiency of the boiler being decreased when the amount of coal consumed per square foot of grate surface per hour is increased, by results of a test made on the Lehigh Valley road, last fall, with an engine having cylinders 20 x 24 inches, grate surface 80 x 114 inches; four pairs of drivers, diameter 50 inches—fuel composed of one-third bituminous and two-thirds buckwheat. The tests were made with the engine in actual freight service. During Test No. 1 the weight of dry coal burned per hour per square foot of grate surface was 25.47, and the water evaporated per pound of coal was 4.115. In Test No. 2 the weight of dry coal burned per square foot of grate surface was 22.65, and the water evaporated per pound of coal was 7.021. In Test No. 3 the weight of dry coal burned per hour per square foot of grate surface was 25.5, and the water evaporated per pound of coal was 6.64. These figures, taken from a test made in actual service, I think go to confirm the results of Professor Goss' experiments, as explained in the paper of to-night.

Mr. MARSHALL ("American Engineer, Car Builder and Railroad Journal")—I think that the apparent conflict between the two statements relating to smokebox temperatures, quoted by Mr. Higgins, is explained by the fact that when making the first one Professor Goss was speaking of the effect of increase in the rate of combustion in regular service, while in the second case he referred only to his own experiments. In service the grate area is constant, and an increase in the rate of combustion results in an increase in the total amount of coal burned per hour; consequently, more heat is generated, even if combustion is somewhat imperfect, the heating surfaces have a greater duty to perform, and the smokebox temperature invariably rises. But in the experiments made by Professor Goss, the increased rate of combustion did not result in a greater quantity of coal being consumed, because the grate area was reduced as the rate increased. As the total quantity of coal consumed per hour remained practically constant, the duty for the heating surfaces to perform would also be constant, unless the more rapid combustion resulted in imperfect combustion, in which case the heat generated would be less, and the smokebox temperature would probably be lower, as stated by Professor Goss in the second quotation given by Mr. Higgins.

The size of the exhaust nozzles has been alluded to by Mr. Higgins and by several others. I think it should be borne in mind that only the boiler was being tested in these trials. The nozzles had to be of such diameters as would give the required draft for the various rates of combustion. If it was so small as to produce considerable back pressure on the engine, that fact was of no importance, for the engine was not being tested. The small nozzle was not, in my opinion, objectionable, unless it can be shown that it in some way altered the character of the draft from what it would have been in regular service, with a larger nozzle and the same vacuum in the smokebox.

Mr. BALL—Something should be said on two points about the exhaust nozzle. Professor Goss' arrangements provided only for testing the efficiency of the boiler. He did not care what the back pressure was in the cylinders, and thus he had to use any size nozzle that would carry out these tests. Now as to the other point: Mr. Higgins compares a statement in the fourth paragraph with one made later on. In the first case he is talking about the general conditions we have in service where we have a fixed grate area, and if we burn more coal per square foot, more heat would be generated; but further on he is speaking of his own particular experiment, and with that fixed amount of coal, if the combustion was not completed, it is evident the smokebox temperature would be lower.

The Secretary read the names of the following twenty-three persons proposed for membership. The Secretary was directed to cast one ballot in their favor, which he did:

Chas. H. Apps,
E. G. Blaisdell,
Rodman B. Bouck,
Chas. W. Culstrain,
Warren Davy,
H. K. Devereux,
W. T. Doughty,
M. E. France,
W. D. Glenn,
H. C. Hunt,
S. T. Hall,
W. H. Marshall,
R. A. P. Meade,
Wm. C. Pullman,
E. S. Page,
W. H. Robinson,
S. L. Smith,
Chas. H. Torrington,
N. B. Trist,
Geo. Tatnall,
Geo. M. Thornton,
J. R. Wagner,
W. Young.

The PRESIDENT—The discussion at the next meeting will be upon "The Heating of Cars," and will be opened by Mr. R. M. Dixon.

The Secretary stated that the Treasurer desired him to make an announcement to the Club of considerable interest—that is, that there is in the treasury $1,318.40 at the present time, and that all bills are paid.

On motion, adjourned at 10:15 P. M.

A. FRENCH, PRESIDENT. GEO. W. MORRIS, GEN'L MGR. D. C. NOBLE, SEC'Y AND TREAS.
J. E. FRENCH, VICE-PRES. P. N. FRENCH, GEN'L SUPT

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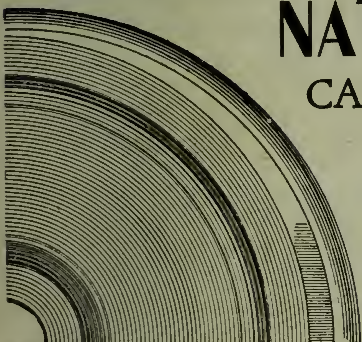

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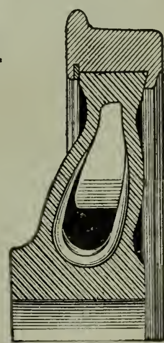

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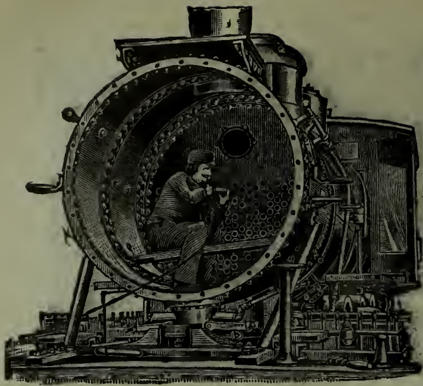

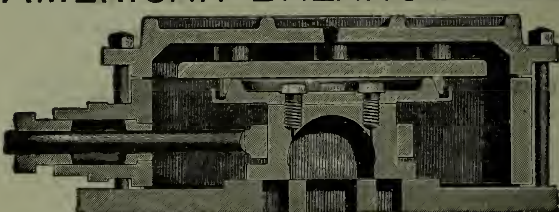

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MURRAY DOUGAL & CO., LIMITED, MILTON, PA.

MEETING OF,
OCTOBER 15, 1896.

New York Railroad Club.

Subject: Car Heating by Steam.

PUBLISHED BY THE CLUB.
W. W. WHEATLY, SECRETARY, 168-170 MONTAGUE ST., BROOKLYN, N. Y.

New York Railroad Club.

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Supt. of Motive Power, N. Y., O. & W. Ry.

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Supt. of Motive Power, Erie Railroad.

Second Vice-President,
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President Metropolitan Street Ry. Co.

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D. M. BRADY,
President, Brady Metal Company.

PROCEEDINGS

of the Meeting held at the Rooms of the American Society of Mechanical Engineers, 12 West Thirty-first Street, New York, on Thursday Evening, Oct. 15, 1896.

Meeting called to order at 8:15 P. M. President West in the Chair. There were 140 members present, among whom were the following:

Alexander, J. R.	Beach, J. W.	Chamberlain, W. E.
Aldcorn, Thos.	Burtis, Wm.	Courtney, W. J.
Barnett, Stephen D.	Banks, W. E.	Colvin, Fred. H.
Barker, M. J.	Brangs, Paul H.	Demarest, D. W.
Bailey, Chas. D.	Belisle, Victor.	Dixon, J. A.
Benson, A. E.	Conklin, Franklin.	Davy, Warren.
Bushnell, E. M.	Cutler, Otis H.	Douglass, C. E.
Brady, D. M.	Collins, G. F.	Dayton, Geo. E.
Bergert, G.	Cromwell, J. E.	Doughty, W. F.
Bowers, R. J.	Culver, S. T.	De Armond, W. C.

De Garmo, T. F.
Daly, David R.
Ellicott, J. R.
Forney, M. N.
Fitzhugh, A.
Fowler, Geo. L.
Gardner, Geo. A.
Gordy, Jas. A.
Gordy, C. E.
Goley, O. C.
Gold, Edward E.
Hill, Rufus.
Hunt, H. C.
Hopkins, C. H.
Hopkins, C. F.
Hayward, H. S.
Hill, Jno. A.
Higgins, S.
Hobart, N. P.
Hillman, W.
Hedley, E. M.
Johnson, W. W.
Johnston, H. C.
Kent, F. S.
Lodge, Wm.
Lewis, Edward
Mallison, E. P.
Moon, J. F.
Major, A.
Morris, W. S.
Molineux, L. E.
Miller, C. C.
Mitchell, A. E.
Minshull, P. H.
Messinger, J. H.
Meeker, Geo. E.
Martin, B. W.
McElroy, Jas. F.
McKeen, T. L.
Phillips, Ed. A.
Patrick, F. M.
Peabody, Jas. C.
Pertell, L. F.
Rauch, W. A.
Rauch, E. J.
Roe, Stewart.
Scott, A. M.
Stevens, M. P.
Sharpe, A. D
Sprigg, W. O
Stewart, J. B.
Smith, C. T.
Taylor, A. B.
Tratman, E. E.
Thompson, W
Turbush, J. H.
Vancil, E. E.
Van Buskirk, J. H.
Vreeland, H. H.
Wheatly, W. W.
Wilson, Geo. P.
Ward, Jno. E.
West, Geo. W.
Woods, J. L.
Woolson, O. C.
Yearance, W. B.
Young, A. W.
Young, W. W.

The PRESIDENT—The next business in order is the reading of the minutes of the previous meeting.

The Secretary read the minutes of the meeting of September 17th, which were approved as read.

The PRESIDENT—The next in order is Reports of Coı Nothing to report under this head.

The next in order is Unfinished Business. Nothing under thi

The next in order is New Business. Has any member anythin under that head? If not we will pass to the next, which is Discuss Technical Subjects. We have a paper presented by Mr. Dixon Heating by Steam." Mr. Dixon, will you open the discussion?

Mr. DIXON (Safety Car Heating & Lighting Company)—M dent, I have had my opportunity in preparing the paper; will b have the rest have theirs. The paper has been printed and distril understood it was not to be read.

Car Heating by Steam.

BY R. M. DIXON.

The advantages of a consideration of the subject of steam heating of railroad trains before the members of the New York Railroad Club will be the greater in proportion to the amount of discussion the members

will give it. Those who are operating steam heat on trains well know the conditions which should be met, and how well the appliances used fill the requirements, what troubles are encountered and how they have to be overcome.

An inquiry amongst those having charge of equipment on cars shows that success is almost universal, so few troubles occur. There seems to be but few instances on any road during entire seasons, and almost all trouble can be either traced to lack of steam circulation in the train pipe, or to insufficient attention to the drips or traps. Cars cut out of trains sometimes have pipes freeze, but this is always due to neglect in opening drainage valves.

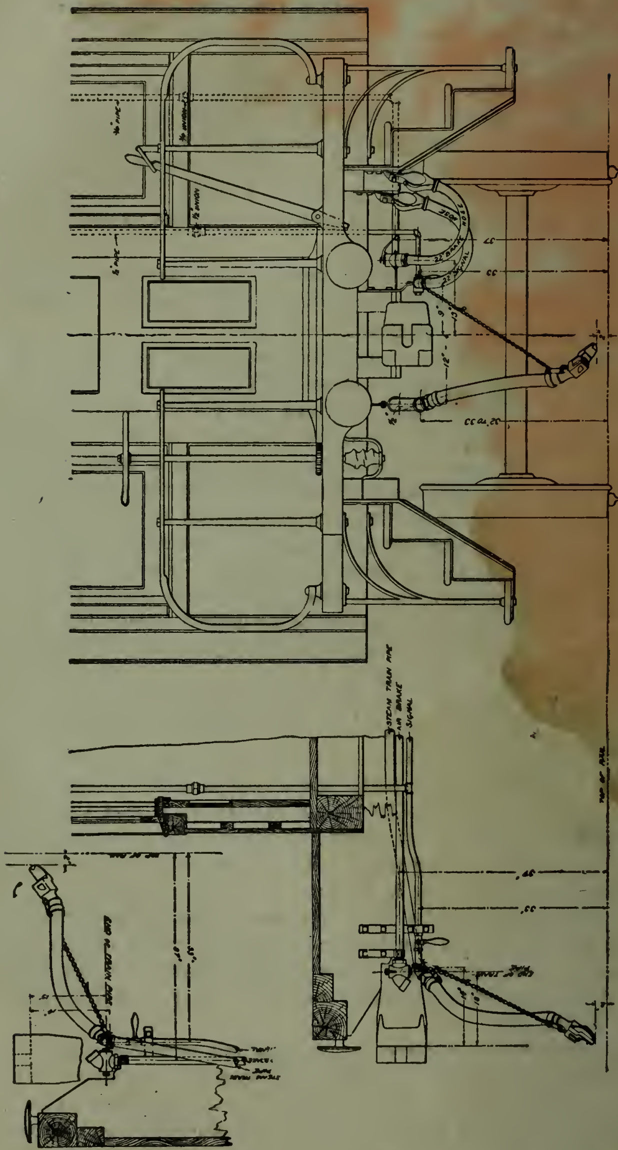
Train pipes as used for all couplers should have their ends conform to the Master Car Builders' position for direction and location. This location is shown by the illustration on page 4.

It is well to bear in mind in placing them that the tendency of the ends of cars is downward, and as the couplers, if hanging uncoupled, will almost strike the switch tracks and crossings, the end of the train pipe should be placed above rather than below the standard position. The train pipe should drain from the point where the car supply is taken off to its ends. If it cannot be done and keep the train pipe below the floor sheathing, then a first-class plan is to run it between the car sills and above the sheathing. In such a place, covering but ⅝-inch thick will suffice; while if below the sheathing, covering 1 inch thick is advisable. The arrangement of the train pipe above the sheathing is standard on some roads, and it has much to recommend it. The cross bracing between the sills has to be bored, and therefore the number of such braces should be increased.

Such train pipe cocks should be used as are readily understood on sight. There is but little time to study out a system when a train is ready for service, and experience teaches that train-pipe cocks are the part of the equipment most difficult to understand. In service all train-pipe cocks but one, the rear one, are to be open, and in cold weather the rear one should be open enough to let just a little steam escape through it so as to maintain a circulation of steam throughout the train pipe, whether or not the rear cars are using steam. This is the practice on many railroads, and seems to be desirable in very cold weather.

The covering should be well applied to the train pipe; otherwise it will not stay on. Instances can be cited where the covering has remained in place but a short time, and more than one-half the train pipe become exposed and in condition to cause more condensation than all the radiating surface in the car.

As to the amount of direct steam-radiating surface in a car, experience has led to the use of two 2-inch standard iron pipes along each side. This is somewhat below what heating engineers would figure as necessary to keep the cars warm in zero weather; but as more has been found very excessive for moderate weather, a sort of compromise has resulted. The


STEAM TRAIN PIPE
AIR BRAKE
SIGNAL
TOP OF RAIL

only way to satisfactorily warm cars by direct steam in all kinds of weather is to have appliances that will permit of varying the amount of radiating surface into which steam is supplied, and so approximate to a suitable heating surface to meet the conditions existing. Such an arrangement also permits of quickly heating cold cars, without overheating them when warm.

All valves and fittings placed inside of the cars should be heavy, and not liable to leak or have the bonnets come off when opening. The valves should have their use cast plainly on the handles.

For direct steam, an automatic trap for discharging the condensation is not necessary, nor desirable. The amount of condensation to be discharged after a car is warmed varies but little, and any increase or decrease of condensation is in the same direction as the change in steam pressure within the radiating pipes. Therefore, an orifice adjusted to take care of the condensation at any pressure will discharge a greater amount of condensation when there is a greater pressure to expel it.

Angle valves are usually used for drip valves, and in many cases have been so arranged as to prevent their being entirely closed. Experience has taught that it is better not to so arrange them. A very simple and safe method of adjusting the drip valves properly was given by Mr. A. M. Waitt, general master car builder, Lake Shore & Michigan Southern Railroad, when discussing this subject before the Central Railroad Club. He instructs to just touch the hand to the drip valve, and if the hand can be borne on it and it is warm, it is all right. If it is so hot that it burns, it is too far open; and if cold, it needs to be opened a little.

With hot-water circulating systems for distributing the heat throughout the cars, the regulation of the temperature is quite easy, and the heat can be carried to various parts of the car without the multiplication of drips for the condensation that is required for direct steam. The various appliances used in hot-water circulating systems are familiar to all and need not be described. There is no trouble in giving to the circulating water by steam a far higher average temperature than is given by the Baker heater, or necessary to heat the cars.

It is desirable, in conjunction with water circulating systems, to use some kind of a device for discharging the condensation, which device shall be in a degree automatic. The rate of condensation is quite variable, and generally the drip is located under the car where it cannot receive close attention. If not automatic and adjusted to discharge sufficiently while heating the circulating water and raising the temperature of the car, it will be too much open after the water is hot and the car warm, and much steam will be wasted, causing not only loss of steam, but damage to car floors and varnish as well as annoyance around the cars.

The following set of rules for handling steam equipment may be found reliable, especially if supplemented by a description of the system in use, and modified as the system may require.

RULES FOR MAKING UP TRAINS.

When a train is made up, all steam hose should be coupled, and all the cocks in the steam train pipe the whole length of the train should be opened.

When signal is given, steam should be turned on at the cab, not to exceed 65 pounds, and allowed to blow through the entire length of the steam train pipe.

After steam issues at the rear end of the train pipe, the rear cock of last car should be closed, and reducing valve in cab set to 40 pounds pressure. If more than eight cars are in the train, add 5 pounds for each additional car. In very cold weather the rear train-pipe cock should be left open enough to allow a little steam to pass and escape through the rear coupling.

REGULATION OF TEMPERATURE.

To heat cars, open steam inlet valves on each car; and when live steam appears at the drips, set each drip so that a little steam escapes with the water. If a trap be used, see that it is adjusted to allow a little steam to escape with the water.

Frequently examine traps and drip valves to see that they are operating properly. They should be as hot as can be borne by the hand. If cooler, or cold, they should be opened a trifle; or if too hot, or steam is blowing, closed a little.

Never close steam inlet valves entirely without first opening drip valves or blow-off valve, and allow water to blow out before closing steam inlet valve.

When steam is required on this car again, open steam inlet valve, and afterwards close drip valves or blow-off valve.

CHANGING ENGINES.

When approaching stations where engines are to be changed, or terminals where cars are to be laid up, five minutes before arriving at such stations the rear train-pipe cock must be opened wide, and before coming to a stop at such stations the engineer must shut off steam at boiler valve. Do not use reducing valve for this purpose.

If engines are to be changed, trainmen must satisfy themselves that steam is shut off at engine before uncoupling cars.

In freezing weather, if cars are to be laid up, or stand thirty minutes after engine is uncoupled, the hose throughout the train must be uncoupled, and all drip valves or blow-off valves opened.

The greatest expense of maintenance of steam equipment is the renewal of the coupling hose. The following set of specifications and rules

for testing are reasonable, and have been found to give good results. At least one per cent. of each lot of steam hose should be tested:

1¼" STEAM HOSE TO CONFORM WITH DRAWING L-246.

1½" STEAM HOSE TO CONFORM WITH DRAWING L-245.

SAMPLES SELECTED AT RANDOM FROM EACH INVOICE MUST DEFLECT 5 IN FOR EACH 24 IN LENGTH, FOR A PULL OF NOT MORE THAN THAT SHOWN IN THE FOLLOWING TABLE:
STEAM AT 45 LBS TO 60 LBS. PRESSURE TO BE ON HOSE 10 HOURS AND OFF 14 HOURS OF EACH DAY.

MAXIMUM ALLOWABLE PULL TO DEFLECT 5 IN

	BEFORE TEST.		DURING TEST OF 2 WEEKS.	
	COLD.	HOT.	COLD	HOT
1¼ IN HOSE	45 ozs	35 ozs	55 ozs	45 ozs
1½ IN HOSE	60 ozs	50 ozs	75 ozs	70 ozs

AFTER TEST THE TUBE AND FRICTION MUST BE IN GOOD CONDITION, AND THE HOSE MUST NOT HAVE IN-CREASED IN OUTSIDE DIAMETER MORE THAN 10 %.

ALL HOSE TO BE SMOOTH, UNIFORM AND WELL FINISHED.

METHOD OF CONNECTION FOR TESTS.

Mr. MITCHELL (Erie Railroad)—I do not quite understand the last article of specifications for hose. I do not quite understand what Mr. Dixon means when he states that the maximum allowable pull to deflect 5 inches must be the several weights stated there. I do not quite understand what he is driving at; would like to have a little explanation on that subject.

Mr. DIXON—We found that one of the greatest troubles we had with hose when in use with automatic steam couplers was that it became stiff after a time, and in case of the couplings opening between the cars they would not fall back in place so that the joint would be tight, and we traced it to the stiffness, and then we found that the manufacturers of steam hose were making hose that would not get so stiff in service as to cause that trouble, and that is the reason we needed that specification. We had samples from a large number of hose manufacturers, and we made those tests in our shop, having steam on this hose daytimes and off nights; and the deflecting tests were made at night when the steam had been on all day, leaving the hose hot, and again in the morning when the hose was cold, before steam had been turned on, and after we subjected hose to that test we had no further trouble of that sort. The maximum force required to deflect the hose as stated must not be exceeded during the two-weeks test, and this test was found to be such that a good many of the manufacturers of rubber hose could meet its requirements. A good many did not on the samples they submitted to us.

Mr. MITCHELL—I do not quite understand it yet. Is the plan to hang that hose up and suspend to the bottom 45 ounces of weight?

Mr. DIXON—We pull horizontally 5 inches, and the pull must be not more than 45 ounces. When the hose requires more than 45 ounces to deflect it 5 inches, it is too stiff to meet the requirement. The pull is horizontal, while the hose hangs vertically. It is a test of the vulcanizing of the hose in service.

Mr. GOLD (Gold Car Heating Company)—I have read Mr. Dixon's paper and made a few notes with regard to this subject:

While it is a fact that the steam-heating of railroad trains has been very successful in many instances where systems of deserving merit have been used, still there are a number of cases where considerable trouble has been occasioned (not so much by the neglect of trainmen to open drip valves, etc., but, in my judgment, by the fact that some heating systems require entirely too much attention on the part of the trainmen), and such method of steam heating is consequently very unsatisfactory.

Therefore, on this account I should not consider that the success attained by steam-heating systems has been quite so universal as a perusal of the paper under discussion would imply.

The perfection of a steam-heating apparatus, in my mind, would be to have the cars equipped in such a manner as would produce a comfortable temperature and to have all parts and appliances which are used to produce such result, by whatever system it may be (whether it is storage, or direct steam, or a hot-water circulating apparatus), as near thoroughly automatic as possible.

There should be no reason why cars cut out of trains should have pipes freeze on account of inattention or neglect of trainmen. It should not be necessary to have the trainmen open any drainage valves whatever, for with an efficient heating system to which traps are connected the condensation will be released automatically.

It is, of course, very important to have the position of the ends of the train pipe conform to the Master Car Builders' standard, but it is not much better to have these ends hung up above the standard measurement than it is to have them hung too low. Of course, if the ends are too low, the couplings are liable to strike the switch tracks; but then again, if too high, it will bring the steam couplers up too near the air-brake coupling and have a tendency to uncouple the latter.

As there is a standard measurement of what the position of the ends of the train pipe should be, and the Master Car Builders have gone to considerable trouble to arrange this standard, there is very little excuse for not having the matter entirely correct, and not too low or too high either.

In reference to covering, we have always made our standard seven-eighths of an inch thick; and then it should be a first-class grade of sectional asbestos covering.

The disadvantage of train-pipe cocks is that after some usage they are liable to stick and become inoperative, and on this account a train-pipe valve which is much simpler in construction and very easy to operate, besides being automatic and self-draining, has found very considerable favor with many railroads.

When steam-heating first came into use for warming passenger cars it was the usual custom to use a three-way cock on the train pipe, and when this was found to be an objectionable device, owing to its leaking and freezing the pipes, and also on account of its sticking, and being difficult to handle and adjust, some few roads then substituted two straight-way cocks and took the steam supply from a point between the two cocks.

This too has been found objectionable, because, although two straight-way cocks will keep tight a little longer than a three-way cock, still they will surely leak in a short time and give the same trouble as the old three-way cock; besides, they are known to stick tighter. It is almost impossible to repair a cock when it gets out of order, and generally when trouble occurs they have to be replaced; consequently, in using two straight-way cocks there is twice the cost for maintenance that there is with one cock, and very considerably more than when a train valve is used.

All train-pipe valves should, of course, be left open, and the one in the rear car closed tightly; because, a train-pipe valve being automatic, and having a trap attached, it will itself release the condensation and allow as free a circulation of steam in the last car as in the first.

I deem it inadvisable to have a man open the cock of the rear car, because he is liable to open it too much and waste considerable steam, or, if he does not open it enough, the condensed steam moving slowly is very liable to freeze the pipes at the end of the car.

I believe that two courses of the two-inch pipes running along each side of the car is sufficient radiating surface to produce a comfortable temperature when a direct steam system is used

Each side should be controlled by a separate supply valve inside the car, and each side should also have its own separate trap for drainage, so that one side of the car is perfectly independent of the other.

In this way the temperature is easily controlled, for then it is possible to turn steam on one or both sides, as may be desired, and consequently all the regulation of the heat that is required by the variation of the outside temperature is easily accomplished. This arrangement would also allow of quickly heating the car when cold, for both sides may be utilized at first and left on, or if the weather does not permit then one side may be shut off, and each side being trapped independently there will be absolutely no danger of freezing.

I heartily disagree with the writer of the paper when he says that "for direct steam an automatic trap for discharging the condensation is not necessary nor desirable."

To substantiate my assertion that steam traps are not only necessary and desirable, but also one of the very best features of a steam-heating apparatus, I will say, that not only are many thousand cars on several of the leading railroads in this country equipped with traps, but every car which has thus far been fitted with steam heat in Great Britain, as well as many more on the Continent of Europe, are also fitted with traps and every one giving entire satisfaction.

I am aware that there is some prejudice against the use of traps, and perhaps justly so, because at the time when the steam-heating of railroad trains was in its infancy many traps of inferior merit were put upon the market, and the dissatisfaction caused by their not working properly has given a bad impression on the subject of steam traps, but this feeling seems now to be fast disappearing.

With a trap the discharge of condensation is taken care of automatically and completely, and a trap is, therefore, in my judgment, far better than a drip valve.

I believe that the best results to be obtained in car-heating can be had by the use of a straight steam storage system, with the mechanical construction of which I presume, most of the gentlemen present are familiar.

A hot-water circulating system is very good, and as Mr. Dixon says, with it the regulation of temperature is quite simple.

In some instances of this kind, however, there has been a large amount of annoyance caused by slow circulation, cold returns, and also by considerable snapping and cracking of the pipes, making a very disagreeable noise. These faults are not found in all systems, however, and in the best now manufactured the circulation is rapid, which produces, of course, a hot return, and there is no unbearable noise of any kind for objection.

With a hot-water circulating system there is at first a great deal of condensation, and I deem it necessary to have an automatic trap, for the purpose of quickly discharging this condensation, and which trap should not be automatic in a degree, as called for in the paper, but thoroughly automatic in all its features.

It seems to me that the nearer automatic a system is, the more general will be its use, and any apparatus which requires the continual attention of the trainman to drip valves, which are located either outside or inside the car, is, in my mind, very unsatisfactory.

The train hand should have little else to do for the steam heat but to open or shut the supply valves for the admission of steam, and if he is compelled to open and close a lot of complicated bleeder valves, etc., etc., at frequent intervals, such close attention to that work will detract from his duty in properly caring for passengers and attending to his other work, in such things as signaling, etc.

With a good automatic trap there is no danger whatever of steam escaping to damage the floor of the car or destroy the varnish.

In the rules for making up the train given on page six, you will note that it says: "All cocks in the steam train pipe the whole length of the train should be left open." Now, then, when a train pipe valve is used, all should be left open except the one in the last car, and this one should be closed tightly, for, as before explained, it is automatic, and will itself take care of all condensation at that point, and naturally there is no need of a man bothering with the rear car thereafter.

With reference to the regulation of temperature, I have already touched on that point, and, as before, would mention to open both supply valves at first, and regulate thereafter.

The use of traps would obviate the necessity for the frequent examinations of valves, and opening and shutting of same, called for in the last three paragraphs about regulation, found on page six.

In changing engines, the steam should be shut off at the locomotive, and the train-pipe valve in the first car closed.

In this way the train will be kept warm for some little time, by keeping all the steam in the radiator pipes, and if the cars are to go out of the station again in half an hour or so, they will still be comfortably heated.

If, however, as the paper says, you open the cock on the rear car, then all the steam leaves the train, and the cars will cool off quickly, requiring a much longer time to get them heated when steam is again turned on.

Here again is found the advisability of the use of an automatic steam trap, for with it steam can be confined in the radiator pipes, and when the condensation takes place it is discharged through the traps, whereas, without the traps, it is necessary, as Mr. Dixon says, to open the cocks on the rear car and also all drip valves, and allow all the steam to escape, so as to prevent freezing.

On page six you will see the paper says, that when cars are laid up, or stand thirty minutes after engine is uncoupled, the hose throughout the train must be uncoupled, and all drip valves and blow-off valves opened; but, when a coupler is supplied with an automatic relief trap, all this trouble of uncoupling is obviated. Continual coupling and uncoupling every time steam is shut off for thirty minutes, and also when cars are laid up, will, in my mind, injure the steam hose very considerably. Furthermore, in case the matter is neglected, there is the very serious liability of frozen couplers.

All things taken into consideration, I believe the couplings should have an automatic relief trap attached. This fact being granted, the great expense mentioned by Mr. Dixon in maintaining steam hose would be materially lessened.

I might state, that largely on account of our using such relief traps on the couplings, and the fact that the rubber companies are undoubtedly producing better steam hose now than in years past, that although we used a great many thousand feet of steam hose last season, we had very few pieces which did not give satisfaction throughout the entire year; in fact, we put

in use nearly sixty thousand feet of steam hose, and had less than two hundred pieces returned for replacement, although we guaranteed to replace every foot sold if it did not last a full season.

Mr. BARBEY (of Barbey & Co., Boston)—I understand here on page six that Mr. Dixon says: "When signal is given, steam should be turned on at the cab, not to exceed 65 pounds." Also, he states in the next paragraph: "After steam issues at the rear end of the train pipe the rear cock of last car should be closed, and reducing valve in cab set to 40 pounds pressure." I would like to ask Mr. Dixon if that is what he allows his engineers or men in charge of that work, to send through the rubber hose 40 pounds of steam.

Mr. MITCHELL (Erie Railroad)—I will answer the question, as Mr. Dixon is not in the railroad service. On the Erie Railroad we made an exhaustive series of tests to demonstrate how much steam was required per car in a train. We found on the first three cars it required about 4 pounds to each car. We found after that you should add about 5 pounds additional per car for about five or six cars, and then you would have to increase the pressure about 7 pounds per car for the balance of the train. We found that the steam would not go through twenty cars with less than 80 pounds of steam. We therefore set the pressure to be carried on our trains as follows: The pressure should not exceed 50 pounds on the locomotive and train pipe unless called for by the conductor, in which case the pressure could be run up to 75 pounds, beyond which our safety valves on the train pipe in the engineer's cab would not permit.

Mr. BARBEY—If the manufacturers of rubber hose were notified that there was that difference, that the railroads were to use 75 pounds of steam to heat their trains, I do not care how many cars, they would meet all the requirements in manufacturing a hose that would not harden. In vulcanizing steam hose they can do it with steam at about 15 to 25 pounds pressure. If you get above that pressure of 15 to 25 pounds you begin to harden that hose. It does not take much steam pressure above 15 or 25 pounds to harden hose, as I believe Mr. Gold knows very well, as he has one of the most perfect testing plants in the country. I have seen hose sent by different establishments throughout the United States to Mr. Gold for testing, and although I assure you I am against hose myself, I like to give the rubber hose men their dues. I have seen hose put on test to stand 15, 20, 25, 30, 35 pounds pressure. Have seen it on at 60 pounds and vulcanized, and it got very hard at 75. I have seen hose supposed to be bought for 15 pounds pressure, and at the end of forty-eight hours of continual pressure it has vulcanized under 60 pounds. The trouble is that the rubber companies do not understand just what the railroad companies want. If they want a hose to remain flexible under 125 pounds pressure the rubber companies can produce it, but you have got to pay better than 56 cents per foot for it when they do. I have seen hose asked for to stand 125 pounds pres-

sure for thirty days, and the parties were willing to pay $1.25 per foot for it. The rubber manufacturers of the United States can produce anything to stand any pressure that is wanted, and that will remain flexible, and I believe Mr. Dixon claims that the hose to be tested should be hung perpendicularly, and this is simply because it vulcanizes or hardens, and he wants to avoid that.

Mr. DIXON—I do not apply a weight to hang it straight, merely so it will drain out. It is to test its flexibility. We know that when coupled in the train it is sometimes not flexible, and we say that in these tests the steam used shall be 45 to 60 pounds pressure.

Mr. BARBEY—The rubber companies can produce a hose that will be as flexible as a kid glove under any pressure. As I stated before, manufacturers do not know what is required. The strength of rubber hose is not in the inner tubing or outer tubing, and they try to meet the requirements of the railroads in what is wanted in every way. Now, in regard to keeping train pipes clear of water, etc., etc., I can hardly say, from what experience I have had in steam-heating, which is very limited, although I have seen some very good results in the heating of buildings and also of train pipes. It is not so much the system used as the way it is put together—if the railroads saw more to the putting of the steam pipes together and the fittings, etc. No doubt the gentlemen who superintend this work are thorough pipers in every shape and form. The men who do the work, though, as a general rule are certainly not the best mechanics. I do not suppose there is to-day one-half the pipers doing that work who understand how to put up a joint properly. They will go to work and take red lead and shove it into the coupling union or connection, and also on the thread on the pipe, and screw it in, and if you ask one-half of them why they do it they say to keep the joint tight. The consequence is that the lead hardens and gets into the valves, and the valves are only half open half of the time, simply because they are stopped up with red lead. I have put traps myself on railroad trains, and found on railroads claiming to use 25 pounds pressure you could not operate it with 100 pounds, and when you take it apart you find it is stuck up with this red lead. And then there is no need to heat with 55 to 60 pounds pressure when you can heat a six-story building with 5 pounds. I know of a building heated with 1 pound of exhaust steam. Any of us can see that place—it is the Marston restaurant, of Boston—heated with 1 pound of exhaust steam. The men employed are not trained to do this kind of work. The reason why we can do it, and cannot keep the train pipe clear of water, is that the trainmen are not paid for that kind of business. They do not know when it is required to blow the train pipe out, and they are always trying to heat water with steam.

Mr. MITCHELL—I have listened very attentively to what the last gentleman has said, and I am surprised to learn that the Boston Belting Company have not known what the railroads require in steam-heating hose, un-

less it is because they have just begun to furnish the Boston railroads that have just introduced steam heat with hose. We have been in the steam-heating business about eight years, and have used 50 to 75 pounds pressure on our train pipes during that time. It was about six years ago I made the test where it required 80 pounds of steam to blow the steam through a train of twenty cars. There was a good deal of friction, to be sure, in the 1½-inch pipe, and a good deal of condensation. It was a cold day, 10 degrees below zero, but at the same time I found how much steam it required. Now, if Mr. Barbey can put 1 pound pressure of steam through a train, he has my permission to come over to the Erie railroad and try it on our direct steam cars. Relative to our system, on our road we use two train-pipe valves. We place our steam pipes, well fitted, between the deafening ceiling and the floor, so that the pipe is not exposed. It is then covered with asbestos and mineral wool. We formerly placed the train-pipe valves in the center of the coach, but found that when the valves broke it cost us a good deal of money to repair; but two years ago we introduced the practice that every time a valve broke we would apply the train-pipe valve under each platform with a stem coming up through the platform floor, so that it could be operated from the platform by an extension on the top end of the valve. By this means we have overcome a great deal of the cost of repairs, and we have found that two train-pipe valves are better than one three-way cock, located inside of the car, on account of the readiness with which it can be repaired. We also found, after two years' experience with an experimental train-pipe valve, that a 1-16-inch hole drilled through the plug in such a way that when the valve was closed live steam would blow out through the 1-16-inch hole into the atmosphere, would allow sufficient escape to prevent any condensation from freezing between the last train-pipe valve and the rear end. With this arrangement we have reduced the cost of maintenance very materially, and have also simplified the care of the rear train-pipe valve by the trainmen. They do not have to change it after it is once started. Mr. Gold remarked that in changing engines it was only necessary to close the valve on the engine, and the train-pipe valve on the first car, and allow the steam to escape through the gravity traps. We have on our road gravity traps, but still insist on blowing out the entire train-pipe before reaching a terminal where the engine is to be changed, for the reason that some inspector might "cripple" a car, which would require cutting it out, and to prevent any delay to the train we take the precaution to blow out the entire train pipe. Where the time of changing engines is not over three or four minutes, no serious delay or trouble would occur in condensation or cooling-off of the coaches.

Mr. GOLD (Gold Car Heating Company)—Mr. Mitchell, I guess, misunderstood me about the traps. I did not say the steam would escape through the gravity trap. I said a trap on the train-pipe valve would relieve the condensation. Of course, where he has the trap closed he would

be able to blow the steam out—that is, a thermostatic trap—the water would be relieved from steam condensation, and there would be no danger of freezing. But they do not take care of the condensation in the car itself from the heating pipes; that is taken care of by the trap on the train pipe itself.

Mr. WEST (New York, Ontario & Western Railroad)—Mr. Mitchell, I think it would be interesting to the members if you would give a little description of how your trains are handled with reference to the steam-heating approaching terminals. I think you have the best arrangements I know of about taking care of the cars and blowing out your pipes.

Mr. MITCHELL (Erie Railroad)—At the request of the President I will state that we have been using steam heat about eight years. During that time we have had cars freeze up, have had no end of trouble; in fact, have had the usual experience; but about five years ago we went into the subject very carefully after having seven or eight cars freeze up, to ascertain the cause and see if we could not introduce some remedies or rules to prevent such occurrences. After looking into the question thoroughly we introduced the rule that trains approaching division terminals where engines are to be changed, or division terminals where the train is to be put away, that ten minutes before reaching such terminal the trainmen should go through the train and fully open every supply valve; that five minutes before arriving time the rear train-pipe valve should be fully opened. As soon as the rear train-pipe valve is opened wide, the engineer immediately notices on the train-pipe gage that the steam pressure has fallen, and he leaves the steam on the train-pipe for about two minutes, when he closes the main valve on the engine, not disturbing the reducing valve. Since these rules have been in effect we have reduced our trouble to a minimum. I would further add that just before a train gets to the terminal, after the train pipe is blown out, the trainman also opens the blow-off cock in the trap and relieves all the traps from water. We have stationary heating plants at our terminals; hence, we do not allow a coach to become cool, unless it goes to the shops for repairs. I might add, in relation to traps, I am a firm believer in traps under the cars. The traps save a great deal of trouble, and I believe in a great measure prevent freezing of train pipes, and also prevent the excessive heating of the trains. Without traps the trainmen always keep the temperature too high for fear the pipes will freeze up. I was riding one severely cold day on a railroad where traps were not used, and happened to sit in a seat near the blow-off end of the steam system. The trainman every five minutes would come to the valve and manipulate it to prevent freezing, but the cars were so hot inside that the passengers were objecting. I should judge the temperature was about 80 degrees. I asked the trainman if he preferred traps or preferred to work without them. He told me he did not want his name mentioned, but he would vote for traps every time.

The PRESIDENT—Mr. Morris, of the Chesapeake & Ohio, is present to-night. Mr. Morris, I believe you are obliged to use steam heat on your road. We will be glad to hear from you about it.

Mr. MORRIS (Chesapeake & Ohio Railroad)—The suggestion is good that we are obliged to use it down there. It reminds me that we are a little conservative in the South about these things, and the condition of steam-heating reminds me very much of the political condition. We have got a very healthy minority there using steam heat, and I am very glad to say that we have got a very healthy minority in the South for a progressive and sound money system politically. I think that the heating of trains by steam, coming back to the same comparison, is one of education, not only to those who superintend the equipment, but to the trainmen also. The Chesapeake & Ohio I do not believe had a failure of steam heat last winter, with the exception of when the cars were in a very severe blizzard in the North, and became disconnected everywhere and anywhere, and there was no attention given to the heating system, but on our own road proper we did not have a failure. We have at all terminals arrangements for heating the cars when detached from the engine. We have no less than six or seven systems on our road. I heard one of the gentlemen allude to the practice of railroads putting on $1.50 men on pipe work. I have been with a good many railroads myself, but I have failed ever to find a man to work for $1.50 per day that could put steam heat properly in a car. We use the best pipe men we can find and pay them about $2.50 per day and still we have a little trouble with the steam heat, principally from the exit of condensation from the traps, in their present form, permitting the condensation to accumulate on the outside of the cars, and very frequently the water, from leaks, will follow the frame of the car and get into the sheathing and blister the paint. I notice in this paper it is recommended that the pipes should be placed between the sills of the car. I do not think that the writer of the paper considered anything except the saving of the steam in protecting his pipes. You cannot make the holes, that connections of the pipes go through, perfectly tight. The condensation or steam will frequently from a leaky valve get up into that point, and from dampness accumulating we have had considerable damage done. Now, we cannot throw away systems that use traps. I should very much dislike to do that, because we have at considerable expense equipped cars with traps on the Chesapeake & Ohio. We started in in the infancy of steam heat, and we have spent a great many thousand dollars bringing it up to what it is. I wish there was some way to get rid of traps. In our present system we have tried a great many different kinds of traps and found the best ones we could use are objectionable on account of allowing any steam or condensation to escape. A great many do not have to operate trains running through a country where the conditions are so diversified. The train starts, and

excessive heat is only needed occasionally before it reaches its terminal. We start from Newport News and Richmond and through that country, and then rise over the mountains some 2,000 feet, and when you get on the mountain it gets very cold, while it is very comfortable down at Old Point Comfort, Richmond and other places in that latitude. But we find that when our trainmen are well posted and the apparatus is looked after, with a thermometer in each car, a specified condition of temperature is maintained and we have very comfortable trains. I have tried a number of thermostats, without very satisfactory results, and find that a small hole drilled through the valve is a very good thing. The opening is never forgotten. But, as I remarked, the most successful train-heating that I have had any experience with has resulted from the trainmen being properly instructed and disciplined to watch the system, and having the proper repairs made to any system when the car comes in. We are putting a great many of our train-pipes now below the sheathing, and jacketing them with asbestos, and covering them with a sheet-iron cover to protect the cloth, and we find from that location the leaks are more readily discovered and corrected. You know that we have a very delicate color on our equipment on the Chesapeake & Ohio, and any defects are very prominent.

Mr. HIGGINS (Lehigh Valley Railroad)—I agree with Mr. Dixon that the trap is not necessary, but I think a trap is desirable, and one reason why to-day some persons are opposed to traps is because we have not had very many good traps. The traps we have used have not done their work as they should have done it. They have been in many cases failures. It seems to me, in connection with the trap matter, there is one point that has been overlooked, and that is whether or not the trap would effect any saving in the coal pile. I propose this winter to find that out by running a train with drip valves, and then taking the same number of cars with traps, making the conditions the same, and find out whether there would be any difference in the consumption of coal or not. From an experience I had some years ago, I am inclined to think that it does make some difference in the coal pile. In the case in question we had a roundhouse fitted up with steam heat, using an old locomotive boiler for the purpose, and we could not generate enough steam to heat that house. We had steam blowing out through a drip valve, but it would not heat the building, and we were at our wits' ends to know what to do. But we attached traps to the steam pipes and had no further trouble in heating the building, and without so much coal, too; and that has made me believe that the trap is a very good thing. I do not believe in heating any building without it, and if it is a good thing on buildings, it seems to me it ought to be a good thing on trains, if you get the right kind.

Now, with regard to the specification on page seven, I hardly think

the railroads could adopt that. We would have, after the hose is received, to take two weeks to test it, keeping the hose in the storehouse in the meantime, and I do not think, for that reason, that railroads could adopt that specification as it stands. There are some other points I want to speak about. Nothing has been said here as to whether there is any preference of the systems to be used in the day coach or sleeping car. As a rule, sleeping cars are equipped with the hot water and day coaches with the direct steam. It seems to me there must be some preference in the matter, and it would be a good thing to find out whether steam or hot water is preferable. Nothing has been said about the amount of pipe required where hot water is used. It speaks of the amount required for direct steam.

The PRESIDENT—I think the members would like to know what pressure Mr. Morris uses on his trains. The conditions under which buildings and trains of cars are heated are very different, and I do not think these proceedings ought to go out with the understanding that it is possible to heat cars with 1 and 5 pounds of steam pressure. I think if Mr. Barbey was to get into a car on a cold day, with even 5 or 10 pounds pressure, he would be very quick to complain of the cold air.

Mr. MORRIS—The length of the train, of course, makes a great deal of difference. Our through trains have a maximum of ten cars, in the winter nothing over nine, in the spring and fall we frequently have ten cars; but we never use over 40 pounds pressure, and after an engine has been changed and 40 pounds pressure has been put back, we reduce that to 25 and carry 25 pounds over the road with ten cars. Of course, with less cars in the train we use less pressure.

Mr. MITCHELL—Were they direct steam or hot water circulation?

Mr. MORRIS—We have direct steam in the baggage cars, and hot water in the other cars. This is the Safety Car Heating & Lighting Company's system that we have in the coaches, and the Sewall drum and McElroy commingler. We have them all connected in the same trains.

Mr. WEST—You are able to heat those mixed systems with 40 pounds?

Mr. MORRIS—Yes, indeed. I do not think the system cuts any figure. The radiating surface in the car does the work. The practice on our road is almost the same as with Mr. Mitchell. It allows in an emergency 75 pounds pressure to be applied, but as a rule we get along with 40 pounds, with a limit of 75 pounds; but this latter is only for extraordinary cases of emergency.

Mr. MITCHELL—With seven cars we would use over 30 pounds pressure. On Train No. 3 we often have fourteen cars; twelve cars is the regular train, and we use 50 pounds of steam, except as the conductor orders 75 pounds.

Mr. DIXON—Referring to Mr. Morris' remarks regarding low steam pressure, he has already stated that he has stationary plants at all terminals, and his cars are kept warm when out of service. Now, it is a very different

thing to maintain the temperature in these warm cars from what is is to heat up a train of cold cars. The reason that high steam pressures have to be used is not because so much more steam is used, but because it is almost impossible to get a pipe larger than 1½ inches under the cars, and in order to force sufficient steam through this for a long train, high pressures have to be used.

I happen to have the data of the test Mr. Mitchell speaks of, and of another test of direct steam-heating of ten cars connected with straight train pipe and 1½-inch full port couplers. With 20 pounds turned on at the engine after one hour, no pressure had reached beyond the seventh car. The radiating pipes in the car were cold at the start.

Mr. Morris spoke of my recommending the placing of the train pipe between the sheathing and the floor of the car. I said that that had much to recommend it, but I give first preference to the plan of placing it below the sheathing. I never heard of the trouble he spoke of as possibly occurring. Several roads have placed their train pipes between the sheathing and the floor.

With water-circulating systems the heat can be distributed wherever desired in a car, and as far as disposing of the condensation of the steam is concerned, it can be carried to one point, while with direct steam many drips might be required.

Referring to the amount of radiating surface, would say that more is usually used with direct steam than with hot-water circulation. It is customary to use two 2-inch pipes against the truss plank on each side of the car for direct steam, but, being so placed, it is not in its most efficient radiating condition. With hot-water circulation the pipes are usually looped under the seats, and furnish very efficient radiating surface. Again, with hot-water circulating pipes a much higher average temperature of the pipes can be obtained with steam-heating properly applied than can be obtained with the Baker heater applied to the same pipes.

Regarding the opening of the rear train-pipe cock in very cold weather, Mr. Mitchell's remarks bear on this. They drilled a hole through their train-pipe valves. The rules suggested were not for any special system. There are probably 11,000 cars in the United States that have no traps on their train pipes, and in cars without traps on train pipes, if the supply to the rear can be closed off, the train pipe becomes dead-ended from the supply to the next car forward using steam; and unless the train-pipe cock can be opened, the condensation in this dead-ended portion of the train pipe will settle to the couplers and freeze.

There is a question I would like to ask Mr. Mitchell. I understand he has specifications for a test for steam hose, and I take it he has samples of each lot received after it is tested. I would like to ask him whether the hose remains in the storehouse until they have approved it or not.

Mr. MITCHELL (Erie Railroad)—About six years ago our purchasing

agent asked me to make tests of several different makes of hose and ascertain which was the best. I had samples sent me and put them on the engines running on regular trains. I found that each one of these hose failed from chafing, and I told the purchasing agent that I did not know which was the best, that they had worn out from contact with the other hose, and if he would send me another lot I would try to find out which was the best. I made up my mind that if chafing was to be the test of hose in service I would make a shop test. I rigged up a rubbing machine to rub one hose against the other, under a pressure of 70 pounds of air. I set the machine going and found that the chafing life of the hose varied from two hours in one case to twenty hours in another, so I reported to the purchasing agent the twenty-hours hose was the best and the two-hours the poorest, and we continued to purchase hose on this test. Later on I found that this test was not worth so much as the guarantee of the manufacturers for two years, and therefore we have abandoned the chafing test on our road.

Mr. WEST—I am glad to hear what Mr. Mitchell says about accepting the hose on the guarantee of the manufacturers. When the purchasing agents tell the rubber manufacturers how to make rubber hose, it is about time to stop. I think if the railroad companies put the rubber companies on their honor they will have less trouble. On our road we have used steam every month, not excepting that very hot month of August last. We have two or three men here who look after our steam-heating, and I will ask Mr. Culver to tell what we carry on the New York, Ontario & Western.

Mr. CULVER (New York, Ontario & Western Railroad)—We carry on our road from about 40 to 50 pounds pressure usually in cold weather. We use nothing but the common globe for a drip valve. We have two cars with automatic drips on, which we find are very good. We shut off the cock on the front end of the train on approaching a station where we change engines, and hold the steam all on the train, which we find is a very good thing to do, as we do not take so much steam from the engine again in charging the train pipe. Then we open the train-pipe valve, which carries off the condensation. Have never had any trouble with condensed water in the pipes. I do not know anything more I can say on this subject.

Mr. MITCHELL—The Pennsylvania Railroad use the return system of steam heat on some cars, I understand, with very good success. I wish there was some representative of the Pennsylvania Railroad here.

Mr. HAYWARD (Pennsylvania Railroad)—The system in use on the Pennsylvania Railroad is the return system, and in our service in moderate weather we heat our trains almost entirely with exhaust steam, having an air pump on engine to produce a vacuum in the return pipe. I think in severe weather we rarely exceed 10 pounds pressure, and generally work in moderately cold weather with 5 pounds pressure, depending upon the length of the train. Of course, the return system is, I have no doubt, somewhat more expensive than the direct system. The pumps are an additional ex-

pense, and the principal trouble we have had is from the pump valve stems breaking; but otherwise we consider it a very successful and an economical system of heating trains, on account of requiring so much less steam from our engines. I think most of the men present know more or less of our system of heating. I know Mr. Dixon has looked into it a good deal, and Mr. Mitchell is conversant with it; but as far as we have gone we are satisfied that it is a good and economical system. The principal trouble is, as I have said, the breaking of the valve stems, and when that occurs we use direct steam, and have to be careful to bleed the return pipes to prevent freezing; and, unfortunately, that is not always done, and then trouble comes when the train has to be made up again for the return trip. I do not know that it has any more merits for controlling the temperature than the direct system, for that depends a great deal upon the care and attention given by the train crews. It can, however, be controlled very readily as well as the other systems.

Mr. WEST—This system necessitates two hose between each two cars?

Mr. HAYWARD—Yes, sir.

Mr. MITCHELL—I would like to ask Mr. Hayward, in case the exhaust pump should fail about half way over the division, whether he would require the same pressure on the return system as we do on the direct system of heating the cars.

Mr. HAYWARD—In that case I think if we used direct steam we would not have to use the same pressure you do. I do not think we would have to go up to 50 pounds. Our instructions are for the engineer to give from 30 to 35 pounds pressure.

Mr. MORRIS (Chesapeake & Ohio Railroad)—I would like to have an expression from some of the gentlemen as to which system is preferable with them, whether the hot-water circulation or the direct steam. That question was put, but I have not heard it answered yet.

Mr. MITCHELL (Erie Railroad)—In answer to Mr. Morris' question, my idea of it is this, for local trains where the passengers are only going to be in the cars a few miles, the direct steam is the proper thing, but on through cars I believe in the hot-water system. You get a more uniform temperature with the hot-water system, you can control it better, and you do not burn the feet of your passengers. You have less than boiling water temperature in the one case, and in the other about 212 degrees plus steam pressure; hence, I believe that the hot-water circulating system gives better service for through trains.

Mr. CREAMER (of W. G. Creamer & Co., New York)—May I be allowed to say something on this subject of steam-heating? Although not in my line exactly, I travel some on railroad trains, and it seems to me the fittings of the cars generally look like an unfinished job. There is such an amount of dirt gets in behind the pipes and around them. I have been in cars where I have seen the dirt filled up to the top of the pipes, and I think

it would make a much more perfect job if we were to cover them up. And then another thing—people spit on them, and then the charwoman who cleans them does it with a wet rag and gets them nasty, and when the steam comes in it fouls the air. My theory of the thing would be to close the pipes in, to put a casing over them down to the floor of the car, and to every seat put a register about 18 inches long that could be manipulated by the passenger. If he got too much heat he could close it. And then in order to perfect the ventilation I would have the air admitted at the side of the car, not at the roof, where the gas and smoke and dust from the engine travel, but on the side of the car; and so far as that is concerned, I would say that I have made an air receiver which has worked to some limited extent yet, but so far with perfect success, and I can take in all the air required, and the cinders taken in with it are driven out as fast as they come in, and after some months' experience have taken off the casting and found not a spoonful of cinders there. The pipes can be kept perfectly clean, and the air in contact with them perfectly pure, I do not know what others think of it, but it strikes me as a nice job. Now, of course, I am not making any comments on the different systems; but I should certainly think from my experience that you would have to have some traps on the pipes.

Mr. WEST (New York, Ontario & Western Railroad)—Evidently, Mr. Creamer, you have never been a trainman, or you would understand the objections to these ventilators and registers. One man wants a temperature of 72 degrees, another 90, and some lady with a wrap on, 40, and I am afraid that someone right behind the gentleman with the ventilator open would be "kicking."

Mr. CREAMER—I stated that between each of these seats there would a register to be manipulated by the person in the seat. He could close that ventilator without moving from his position. I do not see that there could be any objection to that.

Mr. WEST—On the same ground that one passenger raises a window and the man behind him objects.

Mr. CREAMER—Oh, I am not talking about the windows. (Laughter.)

The PRESIDENT—Mr. Stewart, haven't you got something to offer.

Mr. STEWART (West Shore Railroad)—I have not very much, except from a practical standpoint. I think I have the railroad men with me when I take exceptions to the statements of Mr. Barbey, that the officers of the railroad companies, in this part of the country at least, do not understand steam-heating after having had several years' experience with it. We try to get the best men we can. We may not pay as much as they do at Boston; but we are on the outer rim, not at the "Hub," although we hope to get there. Now, with regard to the leakage at the rear end of the train, experience has shown that the pipes will freeze. If you have a very long train, unless you have a slight leakage at the rear of the train you are likely to have trouble in cold weather, and our trainmen at least have been

educated to a point where they know just about how much leakage to leave; and the only trouble we have from freezing pipes is at some division point, with a long train, where an engine is changed, and when coupled up there is not sufficient pressure to send the steam through the train, and the train is not sufficient pressure to send the steam through the train, and the train is held there an unnecessarily long time. The location of the pipe between the sheathing and the floor above it is, to my mind, objectionable, because no matter how well you may cover it up with asbestos, when that car has been in service a long time that covering will become worn, and sparks will lodge under it and cause fires; and as it is covered and out of sight of the inspectors, they would not notice this covering was defective, and only find it out by the escape of steam. There is another very objectionable feature in this steam-heat business, to my mind; and that is, that the rear end of a coach will become heated to excess while the forward portion of it will be cold. I have noticed when traveling on a train on a very cold night that there was a draft of cold air coming in through the cracks around front door and windows, and making the car cold for the first three or four seats back from the front end, while probably in the rear of that coach the people will be complaining about the heat; and I have thought if the steam pipes could be divided so that we could heat the front end of that coach, and the cold air coming in where the heat was distributed would drive a sufficient quantity of it to the rear of the coach so as to make it comfortably warm, the steam being shut off from the section of pipes in the rear of the train.

Mr. FOWLER—I would like to ask that gentleman if I understand that cars were set on fire by the steam heat.

Mr. STEWART—We have had cars set on fire from defective covering, but caused by the sparks getting in there.

Mr. WEST—Sparks from the locomotive, and not from the radiation.

Mr. MITCHELL—There is one thing very important in the water-circulating system of heating. Almost all of the sleeping cars and a great many of the coaches running to-day have the Baker heater system of water circulation, where the pipes are filled with water, and when you try to get circulation, you often fail to get it on one side of the car, while you get it on the other, and this, in my judgment, is caused by a pocket of air accumulating in the cross-over pipes, which compresses as the pressure increases, but sufficient pressure is not obtained to move the water on the other side. This trouble was overcome several years ago by Mr. Geo. H. Johnson, general foreman in our Jersey City shop. I do not know whether Mr. Dixon claims this, as it is illustrated in his catalog; but our man got it up. He decided he would work on a different scheme than formerly, and not fill the pipes with cold salt water directly from the barrel, so he opens the four blow-off cocks in the Baker system and attaches a steam hose to one of them. As soon as the steam would blow out of one valve he would close it, then the next and the next, after which

the steam would blow out of the expansion drum; then by attaching a pipe to same, and passing its open end into a barrel of salt water, the steam would soon heat it up and expel all the air, after which the valve at steam connection is closed; and as the steam condenses, it forms a vacuum in the pipes and lifts the water and fills the pipes with water free from air, which insures freedom from trouble, as mentioned previously.

Mr. DIXON—Mr. Dixon does not claim the honor of that discovery; but sometimes knows a good thing when he sees it. He has, however, a little improvement on heating the brine. Instead of allowing the steam to flow into the barrel of brine, thus diluting it, he carries steam through a coil within the barrel, having a valve at its lower end inside the barrel, and also one outside the barrel. The one inside the barrel being closed, and the one outside opened, the steam passes through the coil and out in the air, heating the brine on its way. When the brine is hot, the outside valve is closed and the inside valve opened, letting a good strong brine flow into the pipes.

Mr. SUMMERS (West Shore R. R)—From the standpoint of taking care of cars, nothing has been said with regard to keeping them cool. Looking at most cars running to-day, it would be evident to most mechanics that we waste very much heat in them. We get excessive heat. We do not have any trouble to keep the cars warm.

With regard to Mr. Mitchell's system of blowing out the train pipes, of course we blow everything clean, free and clear before we let an engine cut loose from the train; and then, no matter what may happen about a car being sent to the shop or put in the wheel-pit for wheels, the steam-heating does not have to be touched, and we are free and clear to attach the steam hose when the time comes. We have had considerable trouble in keeping the pipes tight, to have no steam escaping except at the traps. I do not like to see steam coming out any place except where it should come out. One of the greatest difficulties is to overcome leaks, especially where you have a leaky steam pipe between your sills or between your floor and the sheathing. Then with your car deafening, whatever it might be, mineral wool or something else, a leak of the steam pipe in there would not be discovered until it had done considerable damage to the floor. Indeed, with our steam pipes exposed at the three-way cocks we find they will get leaking, and before we can get them out the floor is warped up and requires removing for quite a number of square feet. This is not very pleasant where the car comes in in the morning and has to go out in the evening.

With regard to the hot-water system, we find trouble from the hot water not heating by reason of the pipes not being thoroughly cleaned out. I have found the very thing of which Mr. Mitchell spoke. Mr. Johnson must have been up to the West Shore and seen the way we do things there. We blow the steam out through the stop-cocks, and then after all pipes have cooled off thoroughly (we do not do it without giving ample time to get

cold) we do just the same as washing out a boiler. We apply cold water with a pressure of about 75 or 80, as we have that pressure at Weehawken, and go through the very same performance with the water that Mr. Mitchell describes with the steam, allowing the water to run until it is as clear as any spring water. I have washed out cars where I thought the dirt would never stop running. It ran as black as ink for 30 minutes. It would not seem possible that so much dirt could accumulate in the pipes.

I think, with regard to hot water, it calls for more attention to the car pipes than they usually get. We have a train which goes out of Weehawken in the evening, the "St. Louis Limited," with three sleepers on rear. I have noticed, about getting the steam to work from the engine that it takes considerably more steam to warm the sleepers; and then there is a difference with regard to the sleepers. To-night, you will have certain sleepers on a train that will work perfectly free with 20 pounds of steam, and circulate from the start; and then again you will find a sleeper, no matter almost what pressure you put on, it will go thumping along. You take this sleeper when it comes back, wash it out, and you will find the very cause I stated—the dirt.

With regard to pressure on sleepers—in some cases the first sleeper will show 20 pounds, and the third one back 5 to 7 pounds. I suppose if we would go further back we would come to a car that would show nothing.

Mr. MORRIS—I have been benefited a great deal by the schemes that have been presented for taking the brine out of the pipes, but this all seems to refer to one system—hot-water circulation. Now, as I stated in the early part of the evening, we have on our road six or seven different systems at work. Now we have one system that we do not ever have any trouble of that kind with at all, and that is one that has been in use since the early stages of steam-heating. I refer to the old McElroy commingler system, that at least, it seems to me, takes care of itself pretty well; and I think Mr. McElroy is in the room here to-night. I would like to have him say, something about it.

Mr. McELROY—I am very much interested in what has been said on the subject of steam heat.

In regard to the question of pounding experienced in connection with systems connected with the Baker heater, I am of the impression that the cause of that pounding has been due to the fact that when the steam is applied in a drum it causes the temperature of the water within the pipe in the drum to rise to the boiling point and free steam is generated. Now, the question as to whether that drum will pound depends on which end of that pipe the displaced steam that is formed will leave that drum. If it goes out at the hot end there is no sound; but if it goes back to the cold end, the inflowing end, where the water is cold, then you are sure to get the pound.

In regard to the commingler system of which Mr. Morris has just spoken, that system is a vertical system. The steam does not pass down

into the inflow pipe. The steam is above and the cold water runs underneath it. If that were placed, however, in a position where the steam would come up in the inflow, or the commingler were placed on its side so that the steam could go into that inflow, I would guarantee you would have a pound.

As to the cause of the Baker heater at times not circulating properly, to which reference has been made, I find that is due largely to the generation of pressure in the expansion drum, pressure on the whole circulating system, due to the fact that when the drum is filled full to its middle point with cold water, and the water is heated and expanded, the air is compressed in the upper part of that drum, and in the great majority of cases it is due to pressure alone; and if you take a car with which you have that difficulty, and at once proceed to the expansion drum and let that pressure off, a car that has stood for hours and not circulated, will not stand for twenty minutes without taking a complete circulation. Another cause I have found—salt water is used in the Baker heater pipes. Salt water has a strong affinity for iron. Oxide of iron is formed and hydrogen gas is thrown off, and that is what causes the dirt in those pipes. The water would have stayed clean if it were not for the decomposition of the iron pipes that is taking place, and that dirt coming from those pipes is oxide of iron. Hydrogen gas has been formed and the pipes are partly filled with it, and the circulation is hindered. If you test that with a candle, as some men have done to their sorrow, an explosion is apt to take place, and in some cases I have known men to be knocked clear off the car from the explosion of hydrogen gas whilst inspecting the condition of the water in the system.

I would like to say a word in regard to train-pipe valves. As is well known, the best valves used are asbestos packed cocks, or some other form of valve or cock, placed near the center of the car, at the point where the steam is taken from the train pipe to the heating apparatus in the car. We had a great deal of difficulty in keeping those cocks tight. I found it simply impossible to keep them tight. We were met with this point in our trains coming in—we would find the rear end of the train pipe frozen. In undertaking to find out why this froze with a cock supposed to be tight, I made some tests. I tested cocks under a steam pressure of 70 pounds, being our shop pressure. I finally found some cocks that would not show any leakage whatever. The cocks were tight with a pressure of 70 pounds of steam, and with a temperature, say, of 300 degrees Fahr. There was no appearance of condensation, it being provided so that water condensation would run away from the cock. I was, however, satisfied that there was still something wrong. On a cold day I connected a piece of pipe to the other side of the cock, and ran this piece of pipe out of the window, thus representing the rear part of the train pipe on the last car, and allowed it to stand. After the pipe had stood in that way, exposed to a temperature considerably below the freezing point, I unscrewed the pipe and looked in it, and found one cock, supposed to be perfectly tight, coated with frost. It took two men

and a boy to turn it. I again screwed that pipe in and allowed it to stand longer, and from perhaps 1 o'clock to 4 it stayed in that position. When I came to examine it the hole was not three-eighths of an inch across, due to frost formed all around in that pipe—all around on the inside of the pipe, and gradually, but surely, closing it up. I finally allowed it to stand until I was ready to take it down, and then I could not get steam through it. I am satisfied that the explanation of it is, that the leakage was so small that the moisture that came through was almost instantly absorbed in the dry air. The warm air of the shop absorbed a large amount of moisture. Of course, what we see of steam is only the visible part. The invisible part of it raises the moisture of the air. As this would go out through the pipe it would become chilled, the amount of moisture would be precipitated, and even with Titus cocks I found it would freeze up. We now use a valve placed at the end of the train pipe, discarding anything in the way of a cock. And we now place the valve at the end of a car so that it can be reached either from the end of the car or from the ground, and leave an opening so that water and a little steam, perhaps, will discharge constantly through the rear coupler. In that way the best results we have had yet in the train-pipe arrangements have been realized.

In regard to thermostatic traps, I will say very frankly that I am not a believer in thermostatic traps, especially I am not a believer in them for live steam cars. The function of a thermostatic trap is simply to vary an opening; but the amount of the opening is a very uncertain one. The thermostatic trap is a device, so far as I have been able to determine by experiments, that at similar temperatures will not give the same discharge under the same conditions. It will for a time, but it gradually changes. As it changes it requires readjustment, and you have the uncertainty of the man who does the readjusting. A more reliable apparatus is made in the form of a valve having a predetermined opening, an opening made with the valve itself, and so arranged that that will give you about the average discharge you wish; and then, whenever you want to blow out your pipes, you simply raise the seat of the valve and let the steam and water discharge through it freely.

In regard to rubber hose, my impression is that great improvements have been made in the construction of rubber hose. I do not agree at all with the statement of the gentleman that the makers of rubber hose have not understood as to what the railroads have wanted. I can testify as to a good many of them that they have understood and that they have been working manfully to meet that requirement. I do not agree with the statement that the makers of rubber hose can make hose that will remain soft at any pressure. I do not think that is correct. It is always a question with soft hose as to when it will get hard, there being two factors producing this condition, time and steam pressure. I think that if we have a guarantee of one year's time it ought to be satisfactory, considering the low price at which it can be bought.

With regard to the regulation of temperature, I am surprised that nothing has been said on that subject. It is a very important subject. It is my impression that a good deal of apparatus put on cars has been designed with one mistake—not only one, but this one I speak of—that the controlling valves by which the steam is supplied from the locomotive through your train of ten to fourteen cars. In each car with direct steam-heating apparatus you will find two about 1-inch valves both drawing steam out of that pipe. If you take fourteen cars you will have twenty-eight of those openings drawing steam out of the train-pipe. The result is this: When you attempt to put steam through a line of these cars—we will say fourteen cars with valves open—you can put on a tremendous pressure and your steam comes, and when it reaches the the first connection it has three ways to go; it can go back to the other cars, and it can go to the two openings in that car. Twenty-eight openings taking steam out of 1½-inch pipe! I think in heating cars a different procedure should be followed in the rules with regard to making up trains. It is easy to send the steam through when the valves are closed. If your valves are all open, then it is a very different question. The truth is, the valves should not be open more than one turn or three-quarters of a turn until the the steam is on your whole train. If you take the amount of condensation that you find in a car in an hour as the heating apparatus is ordinarily operated; supposing you find them with an average of about 75 pounds with cold cars. Now if you take a steam pipe and arrange an opening ¼ inch through which you discharge the steam, and then provide for the condensing steam, you will find this, that all the steam that goes into a car could be passed through a ¼-inch pipe. The truth is that the regulation of the temperature of cars ought to be made through a ¼ or a ⅜ inch opening, and then you would find the difficulty about regulating the intensity of heating in the car will largely disappear. If you take an inch valve in the car you can scarcely lift it off its seat. I do not think the trainman ought to be blamed as much as he has been for the poor regulation of the temperature, for his method of going and shutting it clear off or putting it on. The truth is, the apparatus he has had would not admit of that flow of steam that would come within the limits of the demand for steam when at such times you wish to cut down the heat. It is essential that a small valve should be provided.

I do not wish to speak to you long, but there is one point in which I think a mistake is made on some roads; that is, in blowing out their train pipes, on the supposition that it is necessary to carry out the water that lodges in the train pipe between the engine and the rear car. They will instruct a man about every twenty minutes or half hour to go to the rear and let it blow out. I do not think that condensation takes place in any way that would prevent the steam from going to the last car. The only justification I can think of for having the rear valve leaking is to assure him that his train is all right to let steam run through.

Mr. BARBEY—Mr. McElroy took exceptions in regard to my remarks about the vulcanizing of rubber hose, and saying that rubber hose or rubber will vulcanize or become hard under almost any pressure. It is not right. Pure rubber cannot be vulcanized; pure rubber cannot be melted by steam. Pure rubber will become hard by exposure to cold weather; that is, pure gum as it comes from the trees. The strength of rubber hose is laid in the cotton, principally in the cotton; the rubber hose comes soft and flexible, and the whole of it lies in the inner lining of the tube. If a hose is made thick enough, it can be made to remain pliable for any number of years, under any temperature. I have seen rubber disks made as thick as 3 or 4 feet in diameter and 6 inches in depth, that have stood over 200 pounds of steam pressure and then not become hard at all. The majority of the roads up East—the Boston & Albany, for one, claim that their engineers are not allowed to put more than 25 pounds pressure on their trains. We are told, as manufacturers, that that hose is not to be submitted to more than 25 pounds steam pressure. The New York, New Haven & Hartford, as I understand, have in their roundhouse a printed form or circular, that the engineers shall not carry over 30 pounds steam pressure. I have been told on the Boston & Maine Railroad, by Mr. Bartlett, within the last two or three months, that they would like a hose to stand 25 to 40 pounds pressure; but I have a device to do away with rubber hose, and I am only talking this up with regard to the argument for rubber hose. I would like to see the railroads use 75 to 100 pounds pressure on the train pipe, for the device which I mentioned will stand this pressure—and more, too, if necessary. I have also been told by Mr. Bartlett that the engineers on his road have been instructed, and they have never carried over 30 to 40 pounds at the most. The Maine Central, I have been told by their superintendent of motive power, carry 35 to 40 pounds pressure.

I have seen rubber hose vulcanized and become hard. Now, they cannot tell me that rubber hose ever became hard on 25, 30 or 50 pounds pressure. I know better than that. I have seen 100 pounds pressure put on it on the Boston & Albany, on one train, a train that was going from Boston to New York. That is not the fault of the hose in becoming vulcanized. That is the fault of the quality of the hose. The hose had a pin-hole in its inner lining, and the steam got in between the linings. That hose vulcanized to a certain extent; but, really, it was not what we call in the rubber trade a vulcanized piece of hose. And if Mr. McElroy ever comes to Boston, I would be very glad to show him through the Boston Belting Company's works.

Mr. McELROY—I would like to suggest that I have seen hose vulcanized on which steam has never been placed. It does not require 25 pounds.

Mr. BARBEY—I had shown to me three or four pieces of very thin rubber about the size of a five-dollar bill. There were two of them placed so

that the ends lapped over and a piece was placed on top. They remained for twenty-five years in that position. The bottom piece of rubber was as soft and pliable as the day it was manufactured; the two above that were soft and pliable also, the outer edges excepted, which were exposed to the air. These were brittle, and the top piece was so brittle that it crumbled. I saw that same piece of rubber, which was so pliable, placed in the sun for ten hours. The action of the sun hardened it. You harden hose if you hang it up in the sun. It will spoil it. Let the water remain in it, or put it in a damp place, and it will remain for years.

Mr. MITCHELL—Mr. President, I move that Mr. Dixon be allowed to speak last on this subject, and the subject be closed.

Mr. Mitchell's motion was duly seconded and carried.

Mr. DIXON—I am very much obliged. I have spoken several times already, and will only say a word. Considerable has been said about water in the pipes thumping. I know of an arrangement that has been devised, that will stop that thumping of water in the pipes, whether they be dirty or clean. It is a very simple arrangement.

The PRESIDENT—I declare the discussion closed. The next in order is the Election of New Members.

The Secretary read the names of the following eighteen persons proposed for membership. On motion, the Secretary was directed to cast one ballot for the eighteen persons, which was done:

Barbey, F. A.	Cutler, O. H.	Cattell, W. A.
Coats, F. R.	Dodd, Wm. C.	Gray, Chas.
Loomis, H. N.	Littell, H. M.	McElroy, Jas. F.
McGowan, Jr., W. S.	Massey, Wm. V.	Moser, E. L.
Mast, F. M.	Peoples, Wm. F.	Prior, E. B.
Sevey, Geo. E.	Turner, C. G.	Wallis, J. F.

The PRESIDENT—In accordance with Article 8 of the Constitution, three tellers must be appointed at the October meeting to receive and count the ballots for officers at the November meeting. I will name for that committee, Mr. Huntley, Mr. Molineux and Mr. Gordy.

The next in order is Announcements. I am requested by the Secretary to state that those who have not paid their dues will please do so.

The SECRETARY—I would like to state to the members that our Constitution requires that the nominating ballots be sent out thirty days previous to our meeting at which we hold our annual election, which is in November. Those ballots will be sent to the members and be in their hands the first of next week. The constitutional requirement is that they be returned, through the Secretary, to the Executive Committee not later than three days prior to the annual meeting. I beg to remind the members that when they receive the ballots they should be returned to the Secretary at least three days prior to the annual meeting.

On motion, adjourned at 10:15 P. M. Lunch was served.

ANNOUNCEMENT.

At our November meeting Mr. Curtiss W. Shields will present a paper on the subject of "Compressed Air Motors, their use, the saving which can be effected by their introduction into railroad shops, and in the engineering and maintenance of way departments."

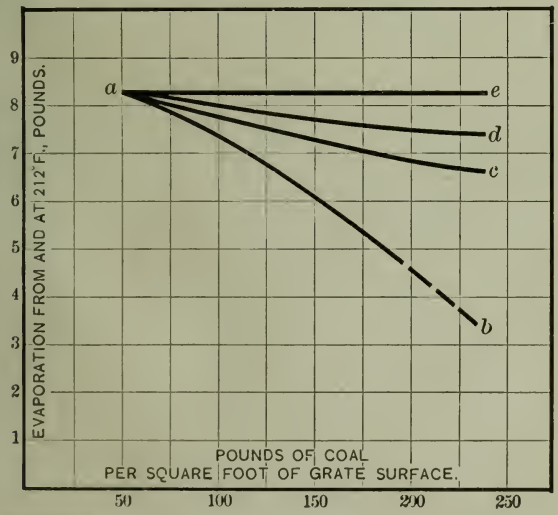
Author's Closure to the Discussion of the Paper Upon "The Effect of High Rates of Combustion on the Efficiency of Locomotive Boilers."*

BY PROF. W. F. M. GOSS.

The discussion of the paper by the Club is so complete that the author has little need to present a closing argument. There are, however, a few matters to which reference should be made.

It has been suggested that the experiments ought to have included rates of combustion which are lower than any for which results are given; but it will be seen that the plan of the tests was such that a lower minimum rate would have involved lower power for all tests, and this seemed undesirable. Moreover, their purpose was to emphasize the effects of very high rates of combustion.

It now appears to the author that the significance of Fig. 2 (which is reproduced herewith) was not as clearly defined by the paper as it ought to



* See Proceedings for September, 1896.

have been. It should therefore be said that the curve *a b* of this diagram represents the relation between the rate of combustion and the evaporation, as obtained from the locomotive "Schenectady" under normal conditions. The curve is an approximate one, and is based upon twenty tests, the results of which did not appear in the paper.

The curve *a c* represents the evaporation for the tests which are especially discussed by the paper; that is, points for this curve were located by dividing the total weight of water evaporated from and at 212 degrees by the weight of dry coal fired.

The curve *a d* was located from the curve *a c* by laying off distances, which were found by multiplying the coal equivalent of the spark losses by the pounds of water evaporated per pound of coal, as shown by the curve *a c;* that is, the curve *a d* represents the evaporation which would have been obtained if there had been added to the amount of coal fired a quantity equal to the spark losses, no acount being made of the extra amount thus added.

An analysis of these relations, especially if taken in connection with a comparison based upon the water evaporated per pound of fuel actually burned, will show that there is no good foundation for the statement that the area *e a d* represents losses due to imperfect action of the grate.* It is unnecessary to discuss the manner in which this error was allowed to enter the paper; nor will the author at this time attempt a revision of this portion of his work. It will be sufficient to say that the mistake is one of deduction rather than of observation, and that as such it does not affect the material facts of the paper. The value of all data presented stands unimpaired, and even the diagram itself is correct if interpreted in accord with the explanation that has been given.

Attention should also be called to Item 45, Test 4, of the published data, where the value which is given as 43,770 should be 34,770.

In conclusion, the author desires to express his appreciation of the courtesies so heartily extended by the Club, and especially to thank the members for their expressions of commendation.

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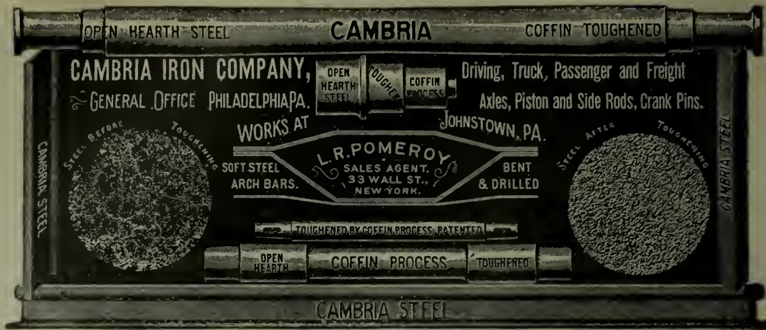
* This error has been pointed out, and has been made the subject of a very able editorial discussion by the "Engineering News" for September 24, 1896.



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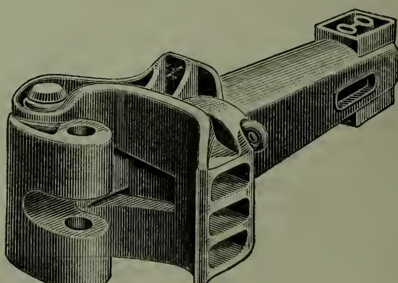

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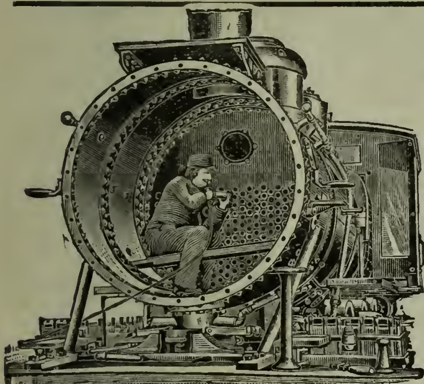


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